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HP 197A

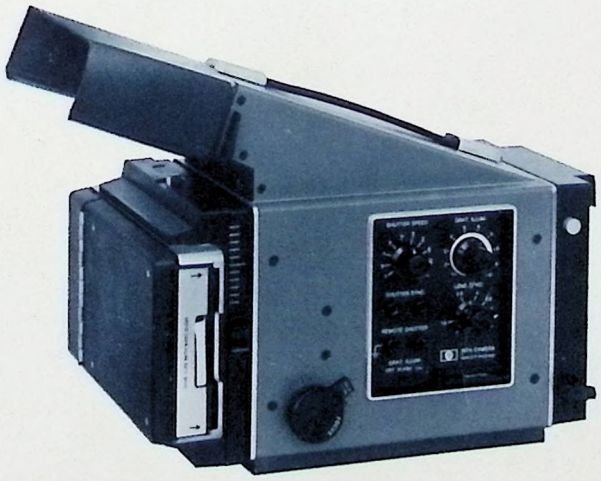
OCT. 1975

OPERATING AND SERVICE MANUAL

# OSCILLOSCOPE CAMERA

## 197A

SN PREFIX = 1528A



HEWLETT hp PACKARD

HP 197A

## CERTIFICATION

*The Hewlett-Packard Company certifies that this instrument was thoroughly tested and inspected and found to meet its published specifications when it was shipped from the factory. The Hewlett-Packard Company further certifies that its calibration measurements are traceable to the U.S. National Bureau of Standards to the extent allowed by the Bureau's calibration facility.*

## WARRANTY AND ASSISTANCE

This Hewlett-Packard product is warranted against defects in materials and workmanship. This warranty applies for one year from the date of delivery, or, in the case of certain major components listed in the operating manual, for the specified period. We will repair or replace products which prove to be defective during the warranty period provided they are returned to Hewlett-Packard. No other warranty is expressed or implied. We are not liable for consequential damages.

Service contracts or customer assistance agreements are available for Hewlett-Packard products that require maintenance and repair on-site.

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OPERATING AND SERVICE MANUAL

# MODEL 197A
# OSCILLOSCOPE CAMERA

**SERIAL NUMBERS**

This manual applies directly to instruments with serial numbers prefixed 1528A.

With changes described in Section VII, this manuals also applies to instruments with serial numbers prefixed: 610-, 730-, 805-, 905-, 913-, and 1203A.

Refer to Section I for instruments with the following standard options: **003, 005, 006, 007,** and **012.**

HEWLETT-PACKARD COMPANY/COLORADO SPRINGS DIVISION
1900 GARDEN OF THE GODS ROAD, COLORADO SPRINGS, COLORADO, U.S.A.

Manual Part Number 00197-90907
Microfiche Part Number 00197-90807

**PRINTED: OCTOBER 1975**

# SAFETY SUMMARY

*The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Hewlett-Packard Company assumes no liability for the customer's failure to comply with these requirements.*

**GROUND THE INSTRUMENT.**

*To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument is equipped with a three-conductor ac power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet International Electrotechnical Commission (IEC) safety standards.*

**DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.**

*Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.*

**KEEP AWAY FROM LIVE CIRCUITS.**

*Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified maintenance personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power and discharge circuits before touching them.*

**DO NOT SERVICE OR ADJUST ALONE.**

*Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.*

**DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.**

*Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to a Hewlett-Packard Sales and Service Office for service and repair to ensure that safety features are maintained.*

**DANGEROUS PROCEDURE WARNINGS.**

*Warnings, such as the example below, precede potentially dangerous procedures throughout this manual. Instructions contained in the warnings must be followed.*

**WARNING**

*Dangerous voltages, capable of causing death, are present in this instrument. Use extreme caution when handling, testing, and adjusting.*

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# SECTION I

# GENERAL INFORMATION

## 1-1. INTRODUCTION.

1-2. The Hewlett-Packard Model 197A is a versatile, general-purpose, oscilloscope camera that can be used for many trace recording applications. All controls are readily accessible for easy reading and fast adjustment during setup. The controls are also color coded for optimum settings for most photographs which reduces initial setup time.

1-3. An electronically-controlled shutter, with all solid-state circuits for reliable operation, provides accurate exposure times from 1/30 to 4 seconds. The shutter may be operated remotely by providing a closure to ground. A contact closure is also provided when the shutter is open to allow synchronization of other equipment.

1-4. This section of the manual contains specifications for the Model 197A. It also lists accessories supplied with the instrument and other accessories and options that are available. Instrument and manual identification information are also included.

## 1-5. SPECIFICATIONS.

1-6. Table 1-1 is a complete list of Model 197A critical specifications. Any changes in specifications due to manufacturing, design, or traceability to the U.S. National Bureau of Standards will be listed on a manual change sheet included with this manual. The manual and the manual change sheet (if any) supersede all previous information concerning specifications of the 197A.

## 1-7. ACCESSORIES SUPPLIED.

1-8. The following accessories are supplied with the 197A:

One Split-image Focus Plate, HP Part No. 1000-0226
One Power Cable, HP Part No. 8120-1348

## 1-9. ACCESSORIES AVAILABLE.

1-10. The following accessories are available for the 197A:

| | |
|---|---|
| Model 10352B | Graflok 10- x 13-cm (4- x 5-in.) back |
| Model 10353A | Polaroid Land pack-film back |
| Model 10354A | Viewing hood replacement plate |
| Model 10355A | Tektronix or Dumont 5-in. bezel adapter |
| Model 10356A | Tektronix 560-series adapter |
| Model 10357A | Tektronix 640-series adapter |
| Model 10358A | Carrying Case |
| Model 10367A | HP Model 182A Oscilloscope bezel adapter |
| Model 10375A | Front-mount adapter for the following X-Y Displays: HP Models 1332A and 1335A; Tektronix Models 601, 602, 603, 604, and 605. |

## 1-11. OPTIONS.

1-12. The following available options extend the usefulness of the Model 197A:

**Option 003.** This option provides the Graflok 10- x 13-cm (4- x 5-in.) camera back. The Graflok back can be used with various film-holder adapters, depending on requirements of the user.

*Table 1-1. Specifications*

**REDUCTION RATIO:** continuously adjustable from 1:1 to 1:0.7. Reference scale provided on focus plate.
**LENS:** 75 mm, f/1.9 high-transmission lens; aperture ranges f/1.9 to f/16.
**SHUTTER SPEEDS:** 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, and 4 seconds, Time and Bulb; shutter has a sync contact closure output for triggering external equipment and an input jack for remote operation.
**CAMERA BACK:** 82.6 mm x 108.0 mm (3-1/4 in. x 4-1/4 in.). Polaroid pack back (other backs are available, see Options); backs are interchangeable without focusing and may be rotated in 90-degree increments.
**MOUNTING:** lift on/off mounting with positive lock, swing-away hinging to left. Mounts directly on most HP oscilloscopes with 12.7 cm (5 in.) round or rectangular CRTs. Adapters are available to fit many other scopes.
**VIEWING:** low-angle, direct viewing through a flexible facemask.
**MULTIPLE EXPOSURE:** back can be moved through 11 detented positions (0.5 cm per detent at 1:0.9 object-to-image ratio).
**FOCUS:** adjustable focusing with lock; split image focusing plate provided.
**DIMENSIONS:** 356 mm long, 267 mm high, 194 mm wide (14, 10-1/2, 7-5/8 in.).
**WEIGHT:** net, 4.5 kg (10 lb); shipping, 7.3 kg (16 lb).
**POWER:** 115 V ±10%, 50 to 400 Hz, 6 watts.

**Option 005.** This option provides a special cable (HP Part No. 00197-61606) to be used when synchronizing the camera with other equipment. The cable is 45.7 cm (18 in.) long with a phone jack on one end, and a 2-pin banana plug on the other end which mates with J1 or J2 on the camera control panel.

**Option 006.** This option consists of the standard instrument modified with a front-bezel mount to facilitate attachment to certain HP X-Y Display instruments (Model 1332A and 1335A), and certain displays built by other manufacturers (such as Tektronix Models 601 through 605). The front mount may be purchased as an accessory (HP Model 10375A) for conversion of the standard instrument.

**Option 007.** This option is the standard instrument modified to meet the U.L. listing requirements for medical and dental equipment. To meet the safety requirements of a hospital atmosphere, changes and additional features have been added to the standard instrument. Further information is available from your HP Sales/Service Office.

**Option 012.** This option is a standard instrument with the power input circuit wired for 230-volt ac operation. Main fuse (F1) is changed to .062 ampere (HP Part No. 2110-0311). Refer to Section VII for circuit information.

## 1-13. INSTRUMENT AND MANUAL IDENTIFICATION.

1-14. Instrument identification by serial number is located on the bottom plate of the instrument. Hewlett-Packard uses a two section serial number consisting of a four-digit prefix and a five-digit suffix, separated by a letter designating the country in which the instrument was manufactured. (A = U.S.A.; G = West Germany; J = Japan; U = United Kingdom.)

1-15. This manual applies to instruments with a serial prefix number as shown on the title page. If changes have been made in the instrument since this manual was printed, a "MANUAL CHANGES" supplement supplied with the manual will define these changes. Be sure to record these changes in your manual. Backdating information in Section VII adapts the manual to instruments with serial numbers lower than that shown on the title page. Part numbers for the manual and the microfiche copy of the manual are also shown on the title page.

# SECTION II

# INSTALLATION

## 2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for installing the Model 197A Camera. Included are initial inspection procedures, power and grounding requirements, installation instructions, and procedures for repacking the instrument for shipment.

## 2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars or scratches and in perfect operating condition upon receipt. To confirm this, the instrument should be inspected for physical damage that may have incurred during transit. If the instrument was damaged in transit, file a claim with the carrier. Check for supplied accessories (listed in Section I) and test the performance of the instrument using the performance test procedures outlined in Section V. If there is damage or deficiency, see the warranty in the front of this manual.

**WARNING**

Read the Safety Summary at the front of the manual before installing or operating the instrument.

## 2-5. POWER CABLES AND RECEPTACLES.

2-6. Figure 2-1 illustrates the standard configurations used for HP power cables. The HP part number directly above each drawing is the part number for an instrument power cable equipped with a connector of that configuration. If the appropriate power cable is not included with the instrument, notify the nearest HP Sales/Service Office and a replacement cable will be provided.

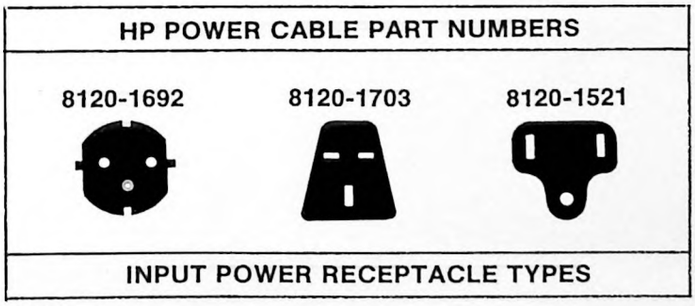



*Figure 2-1. Power Cable Configurations*

## 2-7. POWER AND ENVIRONMENTAL REQUIREMENTS.

2-8. The 197A Camera can be operated from any power source of 115 Vac (±10%) at 50 to 400 Hz. For environmental limitations refer to table 2-1.

**WARNING**

If the oscilloscope chassis is not grounded, be sure that the connection of the grounded case of the camera to the oscilloscope will not present a shock hazard to operating personnel or damage the oscilloscope.

*Table 2-1. Environmental Limits*

| Environmental Condition | With film | Without film |
|---|---|---|
| Maximum storage temperature | 70°C* | 75°C |
| Minimum storage temperature | —30°C | —40°C |
| Maximum operating temperature | 50°C | 55°C |
| Minimum operating temperature | —5°C | —20°C |
| Maximum relative humidity | | |
| —5°C to 50°C | 90% | |
| Over 50°C | 50% | |
| 25°C to 40°C | | 95% |
| **CAUTION** | | |
| Aviod extended operation or storage under conditions of high humidity. | | |
| Altitude: | | |
| Operating | 15 000 ft | |
| Nonoperating | 25 000 ft | |

*For a period not to exceed 8 hours.

## 2-9. MOUNTING INSTRUCTIONS.

2-10. The 197A Camera is designed to fit all oscilloscopes using the standard 14-cm (5-5/8 in.) diameter bezel, or an 11- x 14-cm (4-1/2 x 5-1/2-in.) rectangular bezel. The mounting frame is designed for 2-cm (3/4-in.) bezel depth, permitting direct attachment to most HP oscilloscopes. Refer to Section I for adapters to be used with oscilloscopes that will not accept the 197A directly. To mount the camera on a round bezel, see figure 2-2 for identification of parts and proceed as follows:

a. Adjust mounting lock knob (1) so that locking lever (2) is positioned approximately as shown in figure 2-2.

b. Mount camera on oscilloscope bezel. Press forward gently on camera until mounting retainers (3) hook over lip at rear of bezel.

**NOTE**

The light gasket (4) will be compressed slightly by this action, preventing light leakage into the camera.

c. Position camera so that camera horizontal axis is parallel with horizontal axis of CRT graticule.

d. Turn lock knob (1) clockwise until locking lever is tightened firmly against bezel. Note that lever also hooks over lip at rear of bezel.

2-11. The camera is mounted on a rectangular bezel in the same manner as described above, except that light gaskets (5) must be repositioned prior to mounting. Reposition the gaskets as follows:

a. Loosen two lock screws (6) inside mounting frame, one-quarter turn.

b. Lower gaskets until lock screws are at lower end of slots.

c. Tighten lock screws.

## 2-12. REPACKING FOR SHIPMENT.

2-13. If the instrument is to be shipped to a Hewlett-Packard Sales/Service Office for service or repair, attach a tag showing owner (with address), complete instrument serial number, and a description of the service required.

2-14. Use the original shipping carton and packing material. If the original packing material is not available, the Hewlett-Packard Sales/Service Office will provide information and recommendations on materials to be used.

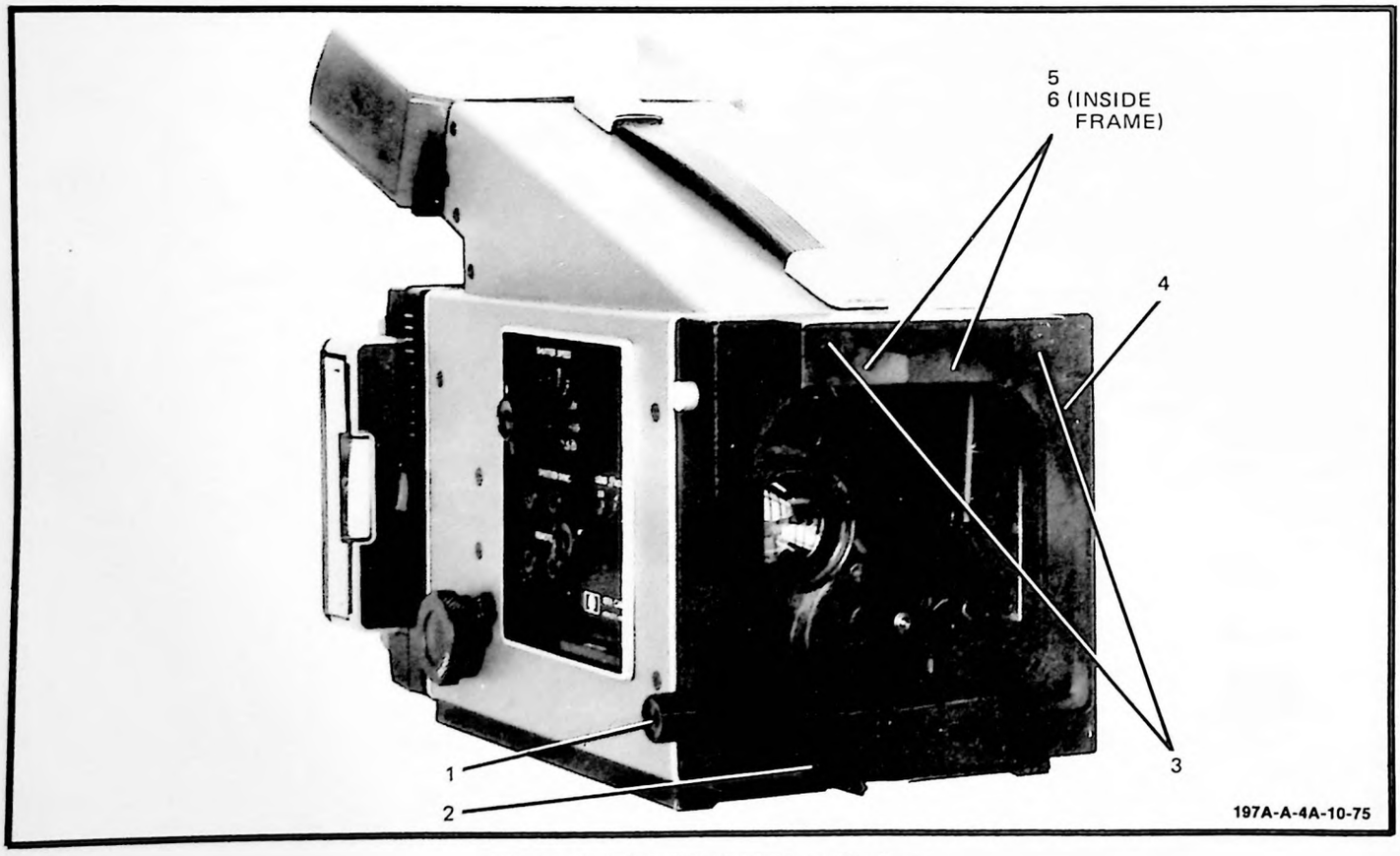



*Figure 2-2. Model 197A Installation*

# SECTION III

# OPERATION

## 3-1. INTRODUCTION.

3-2. This section contains a brief discussion of the operating controls, operating procedures, and basic operating considerations for the Model 197A Oscilloscope Camera.

## 3-3. CAMERA CONTROLS.

3-4. Figure 3-1 identifies and describes the purpose of each control on the 197A. The following paragraphs provide more detailed descriptions of several of the controls.

**3-5. VIEWER LEVER.** A viewer lever on each side of the camera operates the viewer door to permit direct viewing of the CRT screen. The door should be closed when taking a picture, but in most cases enough light is blocked by the face to allow photographing while viewing.

**3-6. SHUTTER SYNC JACKS.** These jacks are connected together through a pair of switch contacts that close when the shutter is actuated, thus enabling synchronization of remote equipment with the shutter action.

**3-7. SHUTTER SPEED SWITCH.** This switch sets the length of time that the shutter remains open. The switch panel indicates the eight calibrated time intervals: 1/30, 1/15, 1/8, 1/4, 1/2, 1, 2, and 4 seconds. The two additioanl switch positions are B (bulb) and T (time). In B position, the shutter opens when the SHUTTER bar is pressed, and closes when the bar is released. In T position, pressing the SHUTTER bar will open the shutter, and pressing it again will close the shutter.

**3-8. LENS f/NO. CONTROL.** This control varies the lens opening (iris) and therefore, the intensity of light transmitted to the film. It is continuously variable from f/1.9 to f/16 (largest to smallest aperture, respectively). The larger the aperture, the shorter the required exposure time for a given film density.

**3-9. REMOTE SHUTTER JACKS.** These jacks are connected in parallel with the shutter control switch. This feature may be used with all shutter speeds and requires a shorting (or grounding) action from a remote source to actuate the shutter.

**3-10. OBJECT-TO-IMAGE RATIO ADJUSTMENT.** The object-to-image ratio for the 197A can be adjust from 1:1 to 1:0.7. The ratio is varied by adjusting the bright-headed screw that is visible when the camera back is moved to the top detent position.

**3-11. MULTIPLE PICTURE DETENT.** The detent button releases the camera back permitting vertical movement to any one of eleven positions. The camera back moves approximately 0.5 cm (0.2 in.) for each detent position, giving a total vertical trace position range of about 5 cm (2 in.) in equal increments. For single exposure pictures, the camera back should be in the center detent position as indicated by the raised pointer on the camera back mounting frame.

## 3-12. FILM DESCRIPTION.

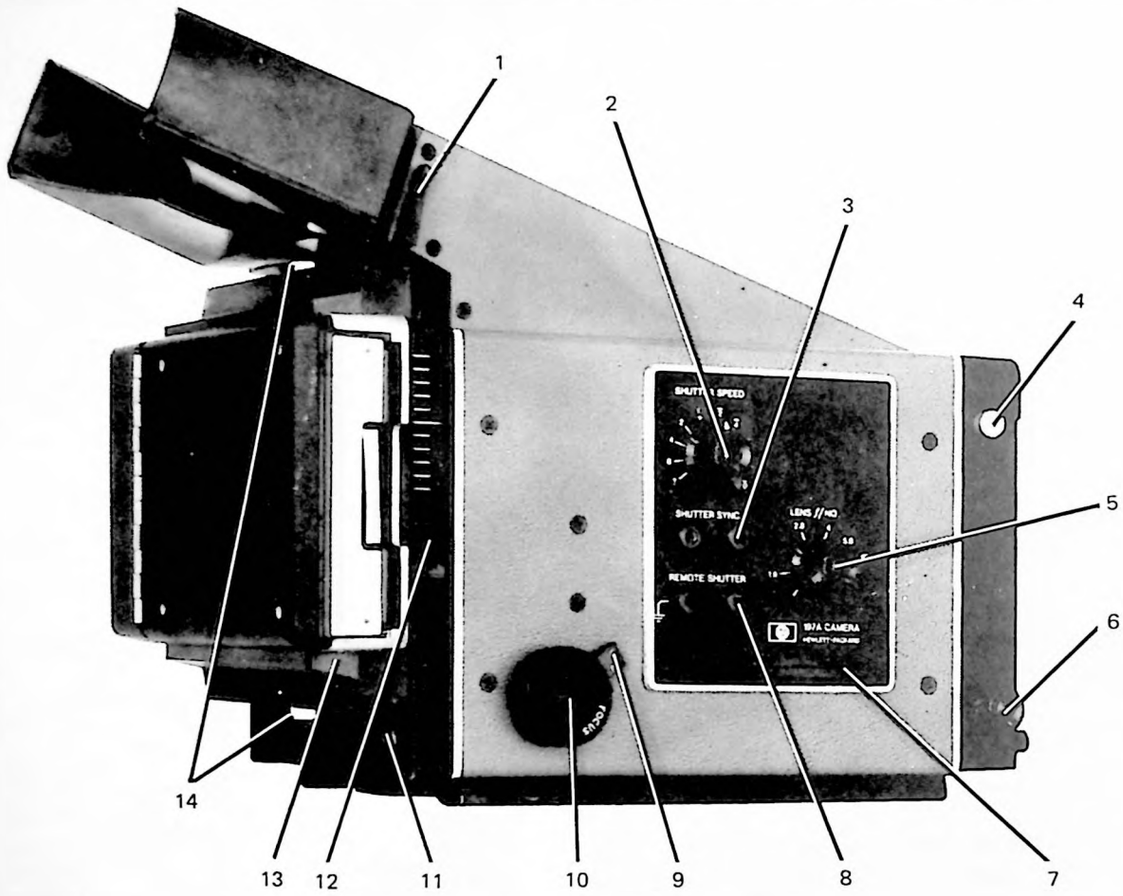
3-13. The film used in the 197A is Polaroid Type 107 film pack that gives eight 8.3- x 10.8-cm (3-1/4- x 4-1/4-in.) exposures. The ASA exposure index for the film is 3000, which makes the film particularly suitable for recording extremely fast transients, as well as all repetitive traces. The prints are developed in 10 seconds by the Polaroid process. A print coater, supplied with each film pack, is used after development for permanence of the print. The negative and film pack cover are discarded after use. Copies and enlargements of the prints may be obtained through the Polaroid Copy Service (refer to instruction sheet supplied with the film pack).

**WARNING**

The Polaroid process uses a caustic reagent which is sealed in containers within the film pack. If the reagent should accidentally come in contact with the skin, wipe it off immediately. Wash the exposed area with water to avoid an alkali burn. It is particularly important to keep the reagent away from eyes and mouth. Keep the discarded materials out of reach of children and animals, and out of contact with clothing, furniture, and equipment because the discarded materials still contain some reagent.

## 3-14. CRT PHOSPHOR.

3-15. Although excellent photographs can be obtained with all commonly-used phosphors, the photographic efficiency of a given phosphor can be important when fast-single, or low-repetition sweeps are to be recorded. Type P11 phosphor has the most suitable light output (1.e., highest photographic efficiency) for photo-




197A-A-5A-10-75

1. **Viewer Lever.** Operates viewer door. (Close before exposure of film.)
2. **SHUTTER SPEED Switch.** Determines length of time shutter is open.
3. **SHUTTER SYNC Jacks.** Output connector for synchronization of external equipment with shutter actuation.
4. **Swing-away Latch Release Button.** Push to release latch, allowing camera to swing-away to the left.
5. **LENS f/NO. Control.** Determines intensity of light transmitted to the film.
6. **Mounting Lock Knob.** Locks camera mounting frame to oscilloscope bezel.
7. **SHUTTER Control Bar.** Press to actuate the shutter control switch.
8. **REMOTE SHUTTER Jacks.** Input connector for actuating the shutter from a remote source.
9. **LOCK Knob.** Locks FOCUS knob in desired position.
10. **FOCUS Knob.** Adjusts camera focus.
11. **Object-to-image Ratio Adjustment Screw.** Varies the object-to-image ratio.
12. **Multiple Picture Detent Release Button.** Press to release detent for moving the camera back vertically in relation to the lens.
13. **Camera Back Lock Release Button.** Push button to the left to open camera back.
14. **Camera Back Lock Nuts (2).** Hold camera back in place on camera frame.

*Figure 3-1. Model 197A Controls*

graphic purposes and should be used when maximum writing rate is desired. Other phosphors, in descending order of efficiency are: P31, P2, P7, and P1.

3-16. In general, a filter over the CRT face degrades quality of the picture obtained, increases the required exposure, and on external graticule oscilloscopes will increase parallax distortion. It is recommended that any filter be removed before taking photographs. An exception is the use of a blue filter to eliminate cathode glow on some unaluminized phosphor CRT's. (A blue filter can also be used to eliminate yellow after-glow of long-persistence CRT's.)

## 3-17. FILM LOADING.

3-18. Complete film loading instructions are given in figure 3-2. The film is most easily loaded with the camera mounted on the oscilloscope; however, film can also be loaded with the camera unmounted.

## 3-19. OPERATING PROCEDURES.

**3-20. GENERAL CONSIDERATIONS.** The procedure required to photograph an oscilloscope display is subject to a number of variables that include: trace intensity, phosphor type, shutter accuracy, filters used, sweep duty cycle and speed, and limitations imposed by depth-of-field. To simplify operation of the 197A, the basic controls (i.e., shutter speed, and aperture) are color coded for optimal settings in normal situations. One or two trial exposures may be necessary when first operating the camera, or when the operating conditions are changed. The procedures given in the following paragraphs assume the use of an internal graticule oscilloscope with the 197A. Special considerations required for external graticule oscilloscopes are given in paragraph 3-33.

**3-21. CRT Filters.** Any filter over the CRT face should be removed before taking photographs, except for special purposes as discussed in paragraph 3-16.

**3-22. CRT Controls.** Trace intensity should be set for good trace detail. In some instances, compromises may be necessary to intensify fast-rise or fall portions of a waveform, or to match trace and graticule intensities. Focus and astigmatism should be adjusted for a sharp trace over the full display area; this should be done with a test signal prior to recording single-shot transients.

**3-23. Shutter Speed Limitations.** The shutter must remain open long enough to record at least one complete sweep, and preferably five to ten sweeps if no drift or jitter is present. When the display contains drift or jitter, the shutter speed should be fast enough so that only a few sweeps are recorded. It should be noted that the time scales on sampling oscilloscopes are not equivalent to sweep speeds on conventional oscilloscopes; since the scanning rate is not a calibrated function, special care should be taken so that at least five scans are recorded. Due to the time required for the shutter control circuit to recharge, succeeding shutter actuations should not be attempted at less than 10-second intervals.

**3-24. FOCUS.** Focusing of the 197A is completely adjustable, and is performed as follows:

a. Mount camera on oscilloscope and apply power to camera.

b. Move camera back to any detent position above center. Remove focus plate from storage compartment on camera bottom. Set camera back to center detent position.

c. Open camera back and insert focus plate.

**NOTE**

If there is a film pack in camera, it must be removed (this exposes top film in pack and it must be removed after pack is reinstalled in camera).

d. Set camera controls as follows:

| | |
|---|---|
| SHUTTER SPEED | T |
| LENS f/NO. | 1.9 |

e. Press SHUTTER bar to open shutter.

f. Verify that focus plate is flat against film frame with proper side toward lens. Adjust FOCUS control until vertical graticule line is no longer split when viewed simultaneously through top and bottom of split-image spot in center of focus plate.

g. When focus adjustment is complete, tighten FOCUS LOCK knob and recheck focus. Remove focus plate and replace in storage compartment. Close shutter and reset all camera controls to normal.

**3-25. RECURRENT SWEEP EXPOSURES.** The procedure given below assumes a stable display of normal intensity. If the display is unstable, a faster shutter speed (smaller number) should be used with a larger aperture (smaller number). It should be noted that approximately the same exposure is obtained by various combinations of shutter speed and aperture (i.e., 1/2 sec at f/5.6 and 2 sec at f/11 correspond to 1 sec at f/8). If the display intensity is weak, and cannot be improved by adjusting the oscilloscope intensity control, a larger aperture should be used with a slower shutter speed.

3-26. To photograph a recurrent sweep display, proceed as follows:

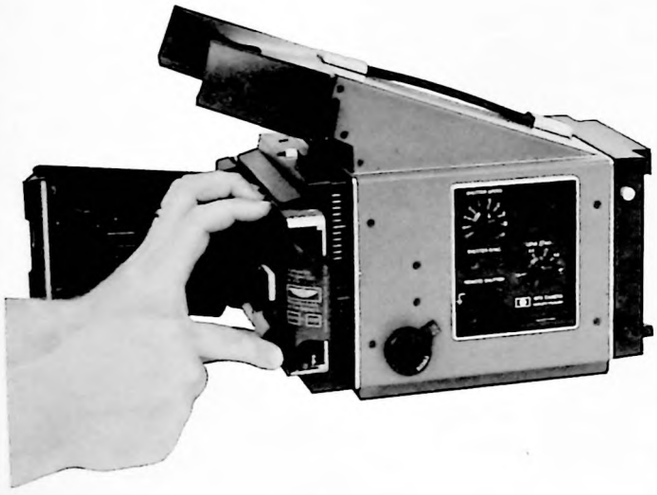
a. Set camera back to center detent position.

**STEP 1**

Unlock camera back cover by pushing lock button to left.

**STEP 2**

Clean rollers with clean, damp cloth or tissue paper.

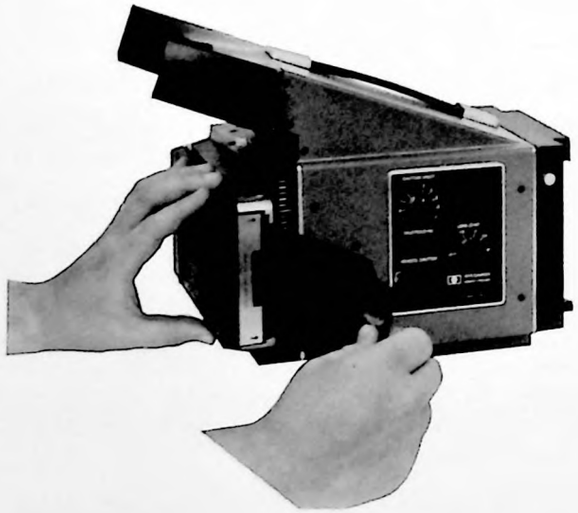


**STEP 3**

With safety cover facing lens, and tabs to right, insert film pack by pushing gently to left and toward lens.

**STEP 4**

Close cover, being sure that black safety cover tab projects out of back from small No. 4 slot. Press both sides of back firmly to be sure they latch.



**STEP 5**

Pull safety cover out of camera to right. Safety cover comes free and must be removed completely before first exposure is made. White tab is now projecting from No. 4 slot, and camera is ready for first exposure.

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*Figure 3-2. Film Loading*

b. Set camera controls as follows:

SHUTTER SPEED ..... 1
LENS f/NO. ..... 8

c. Close viewer door.

d. Press SHUTTER bar to actuate shutter.

e. Develop print (figure 3-4).

**NOTE**

If print is overexposed (too light), use smaller aperture (larger f-number); if underexposed, use larger aperture.

**3-27. SINGLE SWEEP EXPOSURE.** Single-trace photography of fast transients is made possible by the high-sensitivity film now available. Single events which are too fast or too faint for the eye to detect can be captured on this film. In single-trace photography, the oscilloscope should be set up initially using a pulse generator operating at a low repetition rate (30 Hz or less) as a test signal. The low repetition rate avoids the increase in trace brightness caused by phosphor persistence when traces overlap, and permits optimum CRT focus adjustment. During this initial adjustment, the sweep speed should be set for the same speed to be used in the final phtograph. To make a photograph of the desired transient, the camera shutter is held open manually on Bulb or Time while the oscilloscope sweep is triggered once by the signal being photographed. One precaution regarding external graticules concerns parallax (refer to paragraph 3-35) between trace and graticule; allowance for parallax should be made when adjusting the trace height and position. If an internal graticule CRT is being used, parallax is not present.

3-28. To photograph a single-sweep display, proceed as follows:

a. Set camera back to center detent position.

b. Set SHUTTER SPEED to T (or B).

c. Set LENS f/NO. (aperture) wide open (f/1.9) if display is dim, or f/8 if normal. These are trial settings; experience with given conditions will indicate preferred settings. If large aperture is used, focusing becomes critical.

d. Assure good visual presentation of signal when it appears. Set CRT intensity high, but not so high as to cause halo, overriding blanking gate, defocusing, or loss of detail. Check CRT focus on single-shot or low repetition rate signals.

e. Close viewer door.

f. Open shutter.

g. Trigger single sweep.

h. Close shutter.

**NOTE**

If it cannot be determined that shutter is open or closed, set SHUTTER SPEED switch to any position other than T to ensure that shutter is closed.

i. Develop print (see figure 3-4).

**3-29. MULTIPLE EXPOSURES.** Multiple exposures on one photograph are made as follows:

a. Set CRT intensity to normal and center display on CRT. Use low vertical amplitude. Vertical position control is not used after this.

b. Move camera back to one of top detent positions (depending on number of exposures to be taken and vertical amplitude of each signal). Each detent position moves trace approximately 0.5 cm (0.2 in.) on exposed graticule.

c. Expose display, either recurrent or single sweep (refer to paragraphs 3-25 and 3-27).

d. Move camera back to lower detent position (as required).

e. Obtain new display on oscilloscope.

f. Repeat steps c through e for any number of exposures up to eleven.

**3-30. OBJECT-TO-IMAGE RATIO ADJUSTMENT.** Object-to-image (reduction) ratio of the 197A is adjustable from 1:1 to 1:0.7. The focus plate is imprinted with three scales that are used to set the ratio to 1:1, 1:0.9, or 1:0.7. Adjust ratio as follows:

**NOTE**

Ratios apply only to CRT graticules with 1 cm (0.4 in.) graticule lines.

a. Mount camera on oscilloscope and apply power to camera.

b. Move camera back to either one of the top two detent positions and remove focus plate from storage compartment on bottom of camera.

c. Open camera back and insert focus plate.

**NOTE**

If there is a film pack in camera, it must be removed (this exposes top film in pack and it must be removed after pack is reinstalled in camera).

d. Set camera controls as follows:

| | |
|---|---|
| SHUTTER SPEED | T |
| LENS f/NO. | 1.9 |

e. Press SHUTTER bar to open shutter.

f. Ensure focus plate is flat against film frame and adjust object-to-image ratio screw (figure 3-1) until graticule lines are aligned with scribe marks (for desired ratio) on focus plate.

**NOTE**

When adjusting camera for 1:1 ratio, it may be necessary to turn focus plate upside down.

g. When reduction ratio adjustment is completed, check focus and adjust if necessary.

h. Remove focus plate and replace in storage compartment. Close shutter and reset all camera controls to normal.

**3-31. REMOTE SHUTTER AND SHUTTER SYNCHRONIZATION.** The shutter of the 197A may be actuated from a remote source. This function occurs when the remote source closes a circuit between the REMOTE SHUTTER jacks. When this feature is used, there is a mechanical delay between the time that the signal is received and the time that the shutter is actually open. The delay time is as follows (approximately):

| | |
|---|---|
| 5 ms | shutter starts to open |
| 8.5 ms | shutter is half open |
| 12 ms | shutter fully open |

3-32. The SHUTTER SYNC jacks provide a closed circuit when the shutter is actuated. This feature permits synchronization of other equipment with the shutter action. For example, the single sweep action of the oscilloscope could be triggered through this switch action. However, the mechanical delay in actual shutter opening as described above would have to be considered.

## 3-33. EXTERNAL GRATICULE CONSIDERATIONS.

3-34. Several problem areas must be considered when attempting to photograph displays on an oscilloscope with external graticule.

**3-35. PARALLAX.** In the internal graticule CRT, the graticule lines are in the same plane as the phosphor. This arrangement eliminates any parallax between the graticule and the display. With external graticule CRT's, the graticule and phosphor are separated, and parallax enters into the measurement. Two parallax effects, as illustrated in figure 3-3, are present:

a. Parallax caused by the difference between lens viewing angle (B) in figure 3-3 and straight-on viewing angle (A).

b. Parallax caused by the difference between lens viewing angle (B) and eye viewing angle (C).

3-36. Parallax problems can be minimized by making certain that the CRT face is in direct contact with the graticule. If scale measurements are to be made from the photographs, determine the error due to parallax

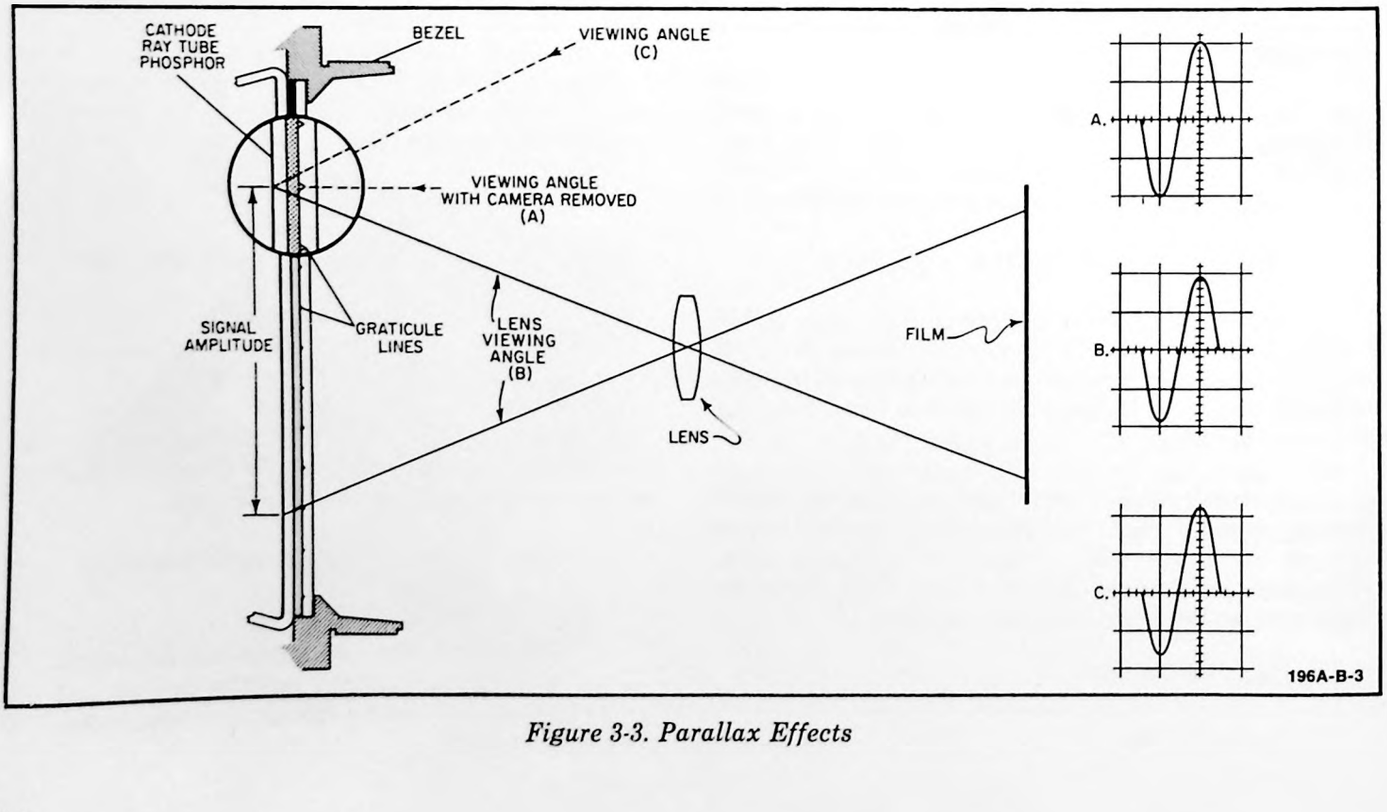



*Figure 3-3. Parallax Effects*

and make the necessary corrections when viewing the display before exposure. For maximum accuracy, make scale measurements near the center of the photograph.

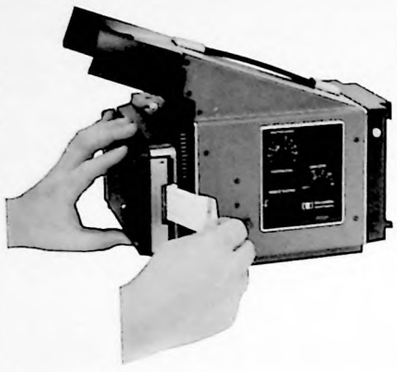
**3-37. DEPTH-OF-FIELD.** An important effect to consider when using an external graticule is depth-of-field, the range of object distances within which the image (formed on the film by the lens) will be in focus. Depth-of-field has an inverse relationship with aperture size; that is, the larger the aperture, the shorter the depth of field. To have both an external graticule and the display in focus at the same time, the aperture should be about f/5.6 or smaller (larger f-number). For this reason, separate exposure of the graticule and display is recommended whenever an aperture larger than f/5.6 is required.

## 3.38. FILM DEVELOPING.

3-39. A step-by-step procedure for developing the film is given in figure 3-4. The development time is 10 seconds at 25°C. In general, developing for longer periods will increase contrast, and developing for shorter periods will increase maximum writing rate. At lower temperatures, the development time required will be longer for the same contrast (e.g., approximately 45 seconds are required at 0°C).

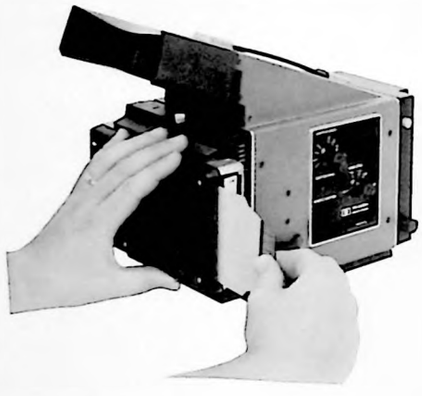
**NOTE**

Prints should be coated as soon as possible after development, using print coater supplied with each film pack.



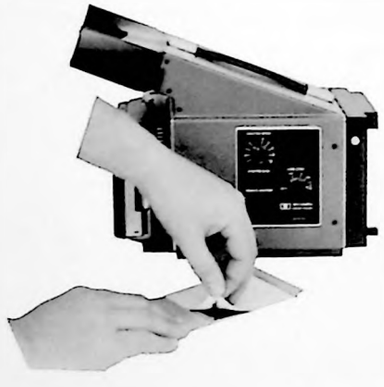
**STEP 1**

Pull white tab out of camera back.



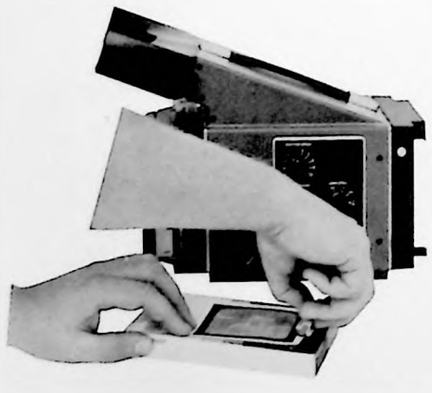
**STEP 2**

Pull yellow tab out of camera back with even, rapid movement. Do not stop midway, or pull at angle (which could tear print).



**STEP 3**

After 10 seconds, peel print from negative paper. Do not hesitate or let print fall back on negative.



**STEP 4**

Coat print with six or eight overlapping strokes. Film pack box may be used to hold print while coating.

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*Figure 3-4. Film Developing*

# SECTION IV

# PRINCIPLES OF OPERATION

## 4-1. INTRODUCTION.

4-2. This section describes operation of the Model 197A. Separate discussions are presented for the camera back, lens assembly, shutter-control circuit, and power supply.

## 4-3. INSTRUMENT DESCRIPTION.

4-4. The 197A consists of three basic assemblies: the camera back, the lens-shutter system and the camera mount. The camera mount holds the lens-shutter system and camera back rigidly in place, providing correct spacing and alignment of the display, lens, and film. The lens-shutter system focuses and controls the amount of light transmitted to the film. The film is contained in the camera back where the development process also takes place.

## 4-5. CAMERA BACK.

4-6. The 197A uses a camera back manufactured by the Polaroid Land Corporation. The camera back holds the film pack and is mounted to the frame of the 197A. The film-development process is initiated within this unit.

4-7. The film-development process is illustrated in figure 4-1. For simplicity, only one negative and one positive are shown. The pressure plate presses the negative stack firmly against the front of the film-pack cover so that the top negative in the stack lies flat in the film plane. After exposure, the white tab is pulled. This positions the exposed negative over the top positive of the positive stack. At the same time, the white tab for the next exposure (not shown) appears at the opening, while the yellow tab is advanced through a second opening. Pulling the yellow tab causes the developer reagent pod to rupture when it passes between the pressure rollers. As the film is drawn out of the camera, the reagent spreads in a thin layer between the positive and negative papers and reacts with the chemicals on these papers. The finished photograph is removed by peeling the print from the negative. The print must then be coated for permanence using the coater supplied with the film pack.

## 4-8. LENS ASSEMBLY.

4-9. The 197A has an f/1.9 lens with a focal length of 75 mm (2 in.). The lens is especially corrected for use in oscilloscope photography to give minimum distortion over the full image area, and to give a flat field of focus. It is positioned at the factory to produce a 1:0.9 object-to-image ratio so that the full 10-cm (3.9-in.) wide graticule may be viewed on the 9.7-cm (3.8-in.) film. This is accomplished by making the effective distance from lens to film 0.9 of that from the lens to the display. This distance can be adjusted to give a 1:1 or 1:0.7 ratio. The camera back is also movable on a vertical plane parallel with the lens to shift the image vertically on the film. The multiple exposure detent provides eleven detented positions, each shifting the image about 0.5 cm (0.2 in.) on the film.

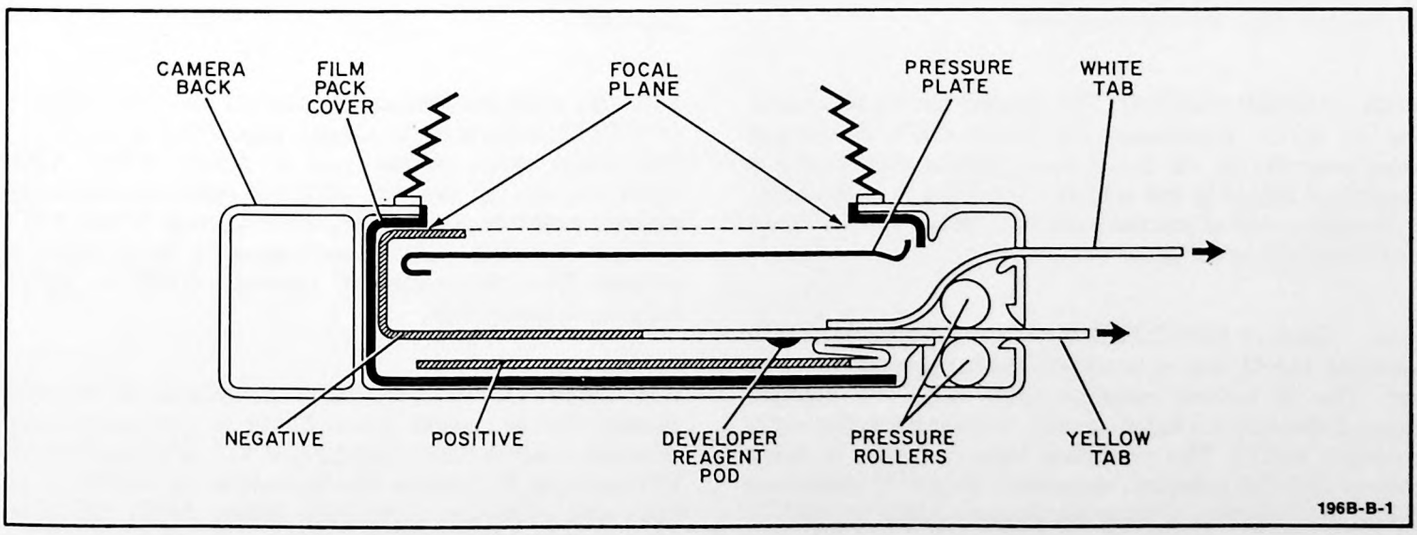



*Figure 4-1. Camera Back Operation*

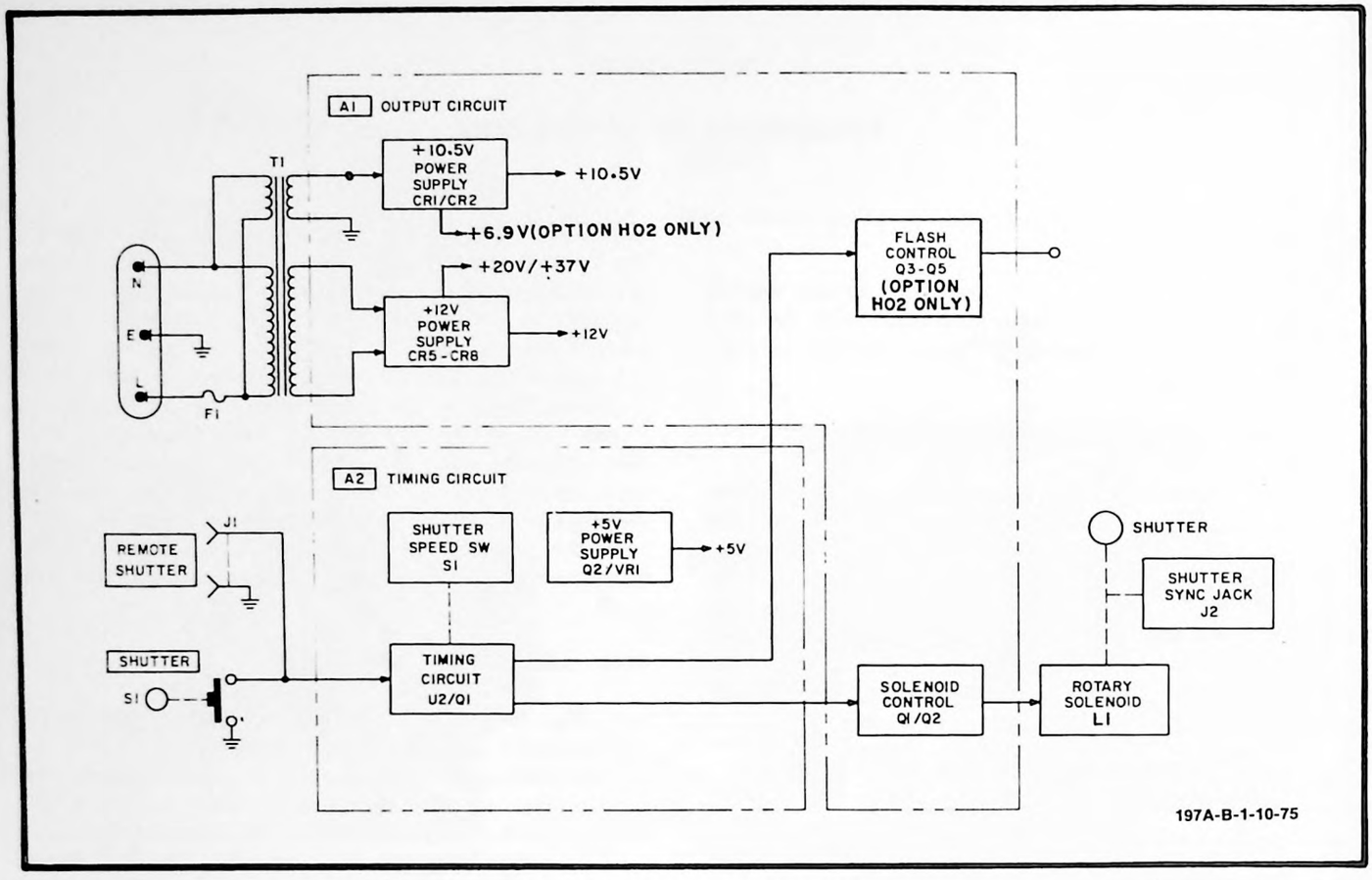



*Figure 4-2. Shutter Control Block Diagram*

## 4-10. SHUTTER.

4-11. Since oscilloscope photograph requires accurate and consistant shutter speeds, the 197A camera has an electronic circuit to control the shutter rather than a conventional mechanical shutter. The shutter control circuit is made up of two circuits: the timing circuit, and the solenoid control circuit. Figure 4-2 is a block diagram of the shutter control circuit. Refer to Section VIII for the schematic.

**4-12. TIMING CIRCUIT.** The shutter timing is controlled by A2U1, capacitors A2C6 and A2C7, A2U2 and transistor A2Q1. At quiescence (shutter closed), the Q output of A2U2 is low and the $\overline{Q}$ output is high. A2Q1 is switched out of the timing circuit in all shutter speed positions except T (time exposure).

4-13. Closing SHUTTER switch S1 activates A2U2, causing the Q output to switch high, opening the shutter. The Q output remains high until the selected timing capacitor (A2C6 or A2C7) charges sufficiently to reset A2U2. The charging time constant is determined by the selected resistance in A2U1 combined with the selected timing capacitor (A2C6 or A2C7). When A2U2 resets, the Q output switches low (closing the shutter).

4-14. When SHUTTER SPEED switch A2S1 is set to T (time exposure), the collector of transistor A2Q1 is applied to the Rx input of A2U2. Closing SHUTTER switch S1 activates A2U2, causing its Q output to go high (opening the shutter). The high output forward biases A2Q1, causing it to saturate. The near zero voltage on the collector of A2Q1 is applied to the Rx input of A2U2, bypassing the timing network. With the voltage at Rx held low, A2U2 stays in the set condition.

4-15. To reset the timing circuit and close the shutter, SHUTTER switch S1 is closed, providing a 5-volt differentiated spike at the base of A2Q1. When A2Q1 turns off, the Rx input to A2U2 is removed, allowing timing capacitor A2C7 to finish charging. When A2C7 finishes charging, A2U2 resets, causing its Q output to go low. The low is applied through A1R3 to A2Q1, keeping it turned off.

**4-16. SHUTTER ACTUATION.** At quiesence (shutter closed), the Q output from A2U2 is low and keeps soleniod control A1Q1/Q2 turned off. Closing SHUTTER switch S1 causes the Q output to A2U2 to go high and saturates A1Q1/Q2. When A1Q1/Q2 saturates, rotary solenoid L1 activates (opening the shutter) and draws the stored charge from capacitor A1C4.

A1C4 assures fast, positive initial actuation of the rotary solenoid. After the solenoid is activated, the power supply provides the sustaining current to keep it activated.

4-17. When the timing circuit resets, solenoid control A1Q1/Q2 turns off. With no sustaining current, rotary solenoid L1 is mechanically closed by internal spring action.

4-18. Before the shutter can be actuated again, it is necessary for A1C4 to charge to a maximum. The charging time is determined by A1R3 and A1C4 (about 2 seconds).

4-19. Rotary solenoid L1 also has a set of relay contacts S2. These contacts close and open at the same time that the shutter closes and opens. S2 provides the shutter sync contact closure to SHUTTER SYNC jack J2.

## 4-20. POWER SUPPLY.

4-21. The 197A has three unregulated power supplies and one regulated power supply. Power transformer T1 has two secondary windings. The first winding provides 6.5 V which is applied to capacitors A1C1 and A1C2 and diodes A1CR1 and A1CR2 (a voltage doubler). This circuit converts the 6.5 V to +10.5 V.

4-22. The second winding output is applied to a full-wave bridge rectifier, consisting of diodes A1CR5 through A1CR8. The output of the rectifier provides +12 V to voltage doubler, consisting of capacitor A1C3 and diodes A1CR3 and A1CR4. The output of the voltage doubler is +37 Vdc (under load this drops to approximately +20 Vdc).

4-23. The regulated power supply uses the +10.5 V power source and regulates at +5 Vdc through A2VR1 in the base circuit of common-base transistor A2Q2.

# SECTION V

# PERFORMANCE CHECK AND ADJUSTMENTS

## 5-1. INTRODUCTION.

5-2. This section contains procedures for checking Model 197A performance and for making necessary adjustments.

## 5-3. PERFORMANCE CHECK.

5-4. The performance check verifies that the 197A is operating within the specifications as stated in table 1-1. This check may be used as an incoming quality control check, as a periodic operational check, or after repairs have been made.

**5-5. SHUTTER OPERATION.** The following procedure verifies shutter operation.

a. Connect power to the 197A.

b. Set SHUTTER SPEED selector switch to T.

c. Press SHUTTER control bar and visually verify that shutter opens. (It may be necessary to open camera back and observe shutter action through camera.)

d. Press SHUTTER control bar and verify that shutter closes.

**5-6. LIGHT LEAKAGE.** Check for light leakage in the 197A as follows:

a. Mount camera on oscilloscope and apply power.

b. Ensure that there is no display on oscilloscope.

c. Set SHUTTER SPEED selector switch to 1 second.

d. Set LENS f/NO. control to 1.9.

e. Press SHUTTER control bar and develop resulting photograph. Resulting print should be completely black.

**NOTE**

If light leakage occurs, refer to Section VIII for possible causes.

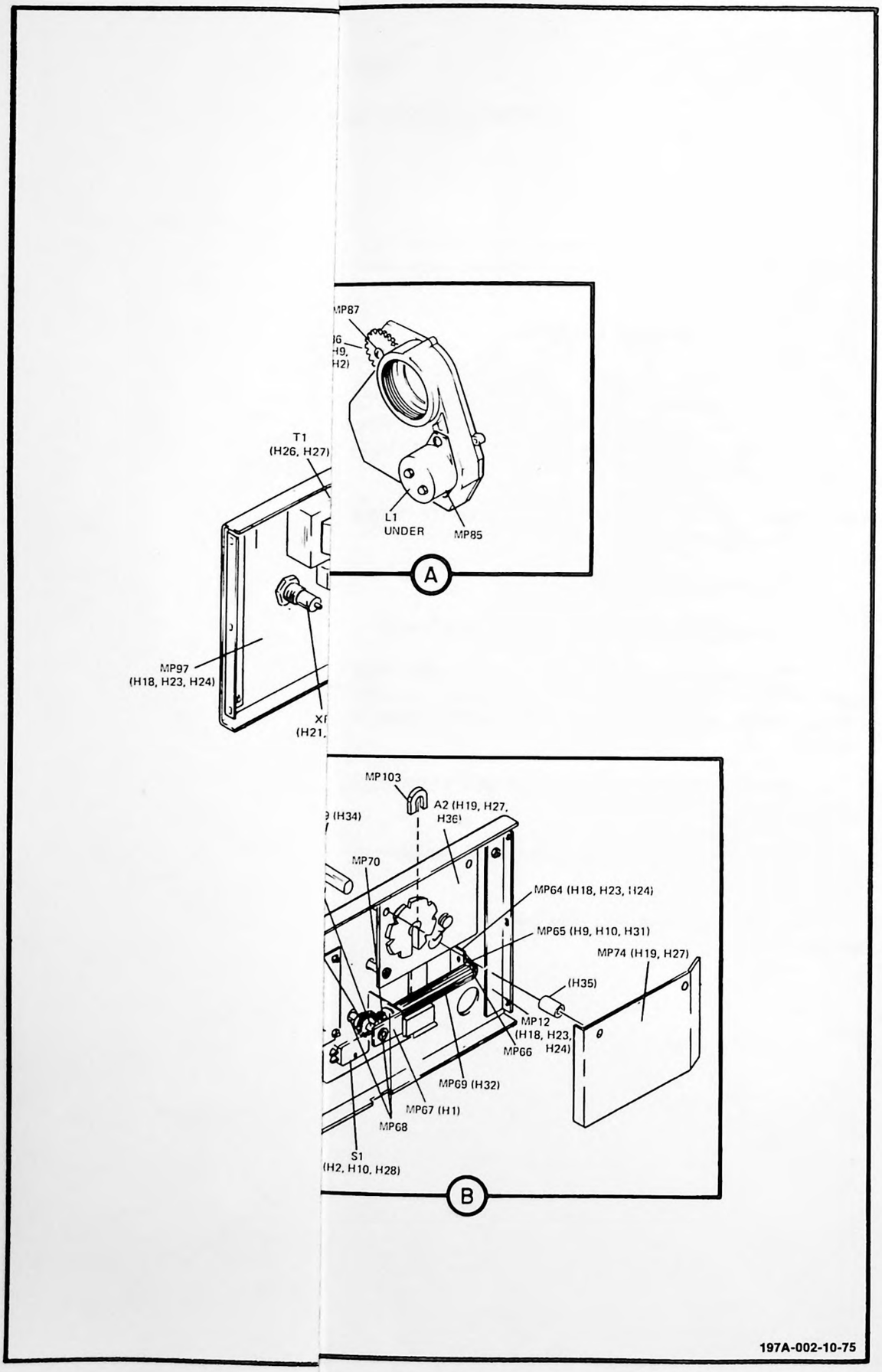
## 5-7. ADJUSTMENTS.

5-8. There are no electrical adjustments for Model 197A. Procedures for two of the three mechanical adjustments, focus and reduction ratio, are given in Section III. The other mechanical adjustment is calibration of the LENS f/NO. control and is performed as follows:

a. Rotate LENS f/NO. control fully counterclockwise.

b. Loosen two knob setscrews and position knob so that pointer is aligned with calibration mark below 1.9 position.

c. Tighten knob setscrews.




*197A Exploded View*

# SECTION VI

# REPLACEABLE PARTS

## 6-1. INTRODUCTION.

6-2. This section contains information for ordering replacement parts. The abbreviations used in the parts list are described in Table 6-1. Table 6-2 lists the parts in alphanumeric order by reference designator and includes the manufacturer and manufacturer's part number. Table 6-3 contains the list of manufacturers' codes.

## 6-3. ORDERING INFORMATION.

6-4. To obtain replacement parts from Hewlett-Packard, address order or inquiry to the nearest Hewlett-Packard Sales/Service Office and supply the following information:

a. Instrument model and serial number.

b. HP Part Number of item(s).

c. Quantity of part(s) desired.

d. Reference designator of part(s).

6-5. To order a part not listed in the table, provide the following information:

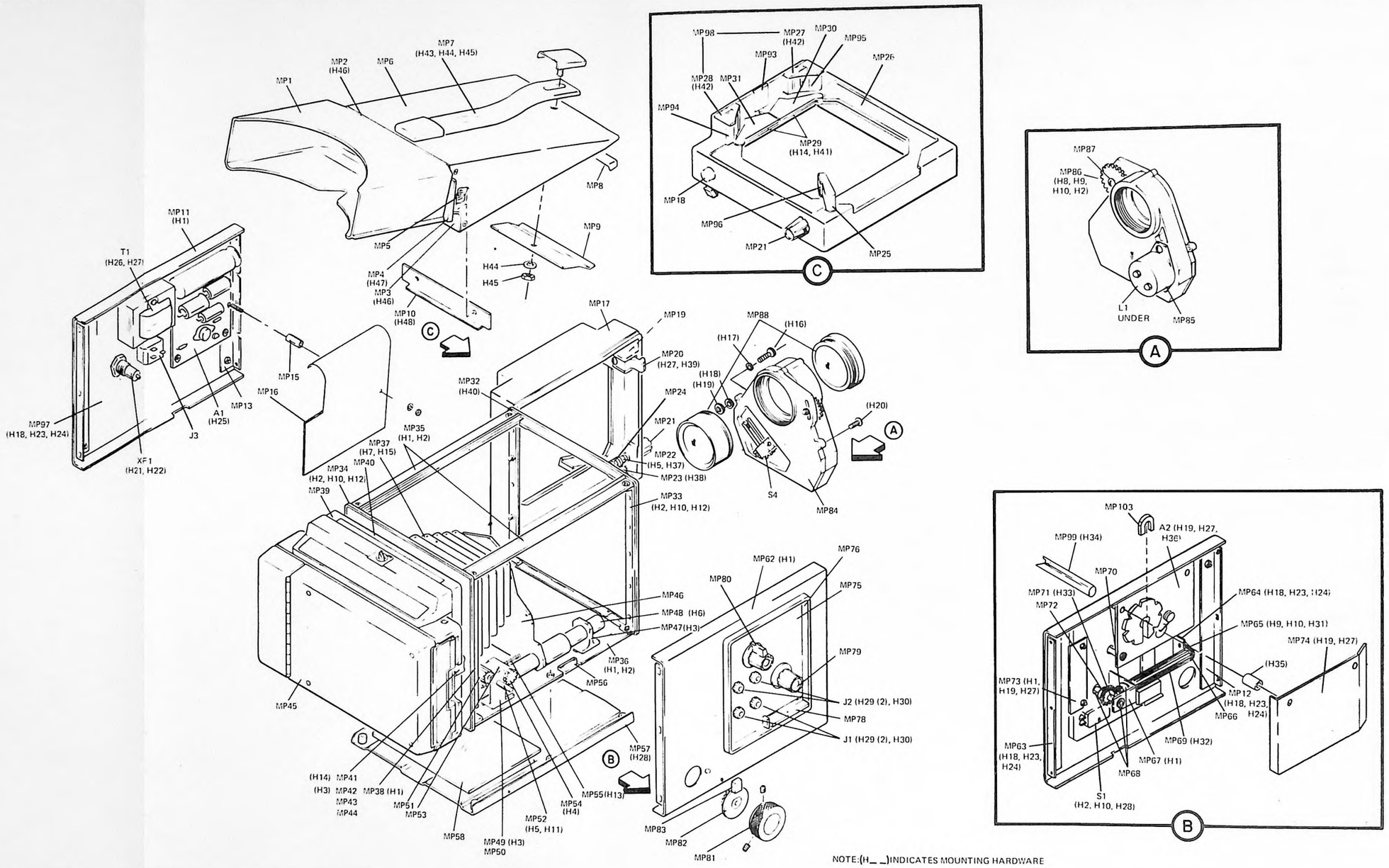
a. Instrument model and serial number.

b. Description of the part, including function and location in the instrument.

c. Quantity desired.

Table 6-1. Abbreviations for Replaceable Parts List

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| A | = ampere(s) | GRD | = ground(ed) | NPO | = negative positive zero (zero temperature coefficient) | RWV | = reverse working voltage |
| ASSY | = assembly | H | = henry(ies) | NPN | = negative-positive-negative | S-B | = slow-blow |
| BD | = board(s) | HG | = mercury | NSR | = not separately replaceable | SCR | = silicon controlled rectifier |
| BH | = binder head | HP | = Hewlett-Packard | | | SE | = selenium |
| BP | = bandpass | HZ | = hertz | OBD | = order by description | SEC | = second(s) |
| C | = centi ($10^{-2}$) | IF | = intermediate freq. | OH | = oval head | SECT | = section(s) |
| CAR | = carbon | IMPG | = impregnated | OX | = oxide | SI | = silicon |
| CCW | = counterclockwise | INCD | = incandescent | P | = peak | SIL | = silver |
| CER | = ceramic | INCL | = include(s) | PC | = printed (etched) circuit(s) | SL | = slide |
| CMO | = cabinet mount only | INS | = insulation(ed) | PF | = picofarads | SP | = single pole |
| COAX | = coaxial | INT | = internal | PHL | = Phillips | SPL | = special |
| COEF | = coefficient | K | = kilo ($10^{3}$) | PIV | = peak inverse voltage(s) | ST | = single throw |
| COMP | = composition | KG | = kilogram | PNP | = positive-negative-positive | STD | = standard |
| CONN | = connector(s) | LB | = pound(s) | P/O | = part of | TA | = tantalum |
| CRT | = cathode-ray tube | LH | = left hand | PORC | = porcelain | TD | = time delay |
| CW | = clockwise | LIN | = linear taper | POS | = position(s) | TFL | = teflon |
| D | = deci ($10^{-1}$) | LOG | = logarithmic taper | POT | = potentiometer(s) | TGL | = toggle |
| DEPC | = deposited carbon | LPF | = low-pass filter(s) | P-P | = peak-to-peak | THYR | = thyristor |
| DP | = double pole | LVR | = lever | PRGM | = program | TI | = titanium |
| DT | = double throw | M | = milli ($10^{-3}$) | PS | = polystyrene | TNLDIO | = tunnel diode(s) |
| ELECT | = electrolytic | MEG | = mega ($10^{6}$) | PWV | = peak working voltage | TOL | = tolerance |
| ENCAP | = encapsulated | MET FILM | = metal film | | | TRIM | = trimmer |
| EXT | = external | MET OX | = metal oxide | RECT | = rectifier(s) | U | = micro ($10^{-6}$) |
| F | = farad(s) | MFR | = manufacturer | RF | = radio frequency | V | = volts |
| FET | = field-effect transistor(s) | MINAT | = miniature | RFI | = radio frequency interference | VAR | = variable |
| FH | = flat head | MOM | = momentary | RH | = round head or right hand | VDCW | = dc working volt(s) |
| FIL H | = fillister head | MTG | = mounting | RMO | = rack mount only | W | = watt(s) |
| FXD | = fixed | MY | = mylar | RMS | = root mean square | W/ | = with |
| G | = giga ($10^{9}$) | N | = nano ($10^{-9}$) | | | WIV | = working inverse voltage |
| GE | = germanium | N/C | = normally closed | | | W/O | = without |
| GL | = glass | NE | = neon | | | WW | = wirewound |
| | | N/O | = normally open | | | | |




NOTE:(H_ _)INDICATES MOUNTING HARDWARE

197A-002-10-75

*Figure 6-1. Model 197A Exploded View*

Table 6-2. Replaceable Parts

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A1 | 00195-66505 | 1 | OUTPUT CIRCUIT BOARD ASSY | 28480 | 00195-66505 |
| A1C1 | 0180-0104 | 1 | C:FXD ELECT 200 UF +75-10% 15VDCW | 56289 | 30D207G015DF4-DSM |
| A1C2 | 0180-0094 | 1 | C:FXD ELECT 100 UF +75-10% 25VDCW | 56289 | 30D107G025DD2-DSM |
| A1C3 | 0180-0141 | 1 | C:FXD ELECT 50 UF +75-10% 50VDCW | 56289 | 30D506G050DD2-DSM |
| A1C4 | 0180-1784 | 1 | C:FXD ELECT 1000 UF +75-10% 40VDCW | 28480 | 0180-1784 |
| A1C5 | 0180-0045 | 1 | C:FXD AL ELECT 20 UF +75-10% 25VDCW | 56289 | 30D206G025CB2-DSM |
| A1CR1 | 1901-0045 | 10 | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR2 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR3 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR4 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR5 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR6 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR7 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR8 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR9 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1CR10 | 1901-0045 | | DIODE:SILICON 0.75A 100PIV | 04713 | SR1358-7 |
| A1Q1 | 1854-0053 | 2 | TSTR:SI NPN | 80131 | 2N2218 |
| A1Q2 | 1854-0072 | 1 | TSTR:SI NPN | 80131 | 2N3054 |
| A1Q3 | 1854-0071 | 3 | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q4 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A1Q5 | 1853-0012 | 1 | TSTR:SI PNP | 80131 | 2N2904A |
| A1R1 | 0684-1011 | 1 | R:FXD COMP 100 OHM 10% 1/4W | 01121 | CB 1011 |
| A1R2 | 0687-1211 | 1 | R:FXD COMP 120 OHM 10% 1/2W | 01121 | EB 1211 |
| A1R3 | 0761-0037 | 2 | R:FXD MET OX 390 OHM 5% 1W | 28480 | 0761-0037 |
| A1R4 | 0687-4701 | 1 | R:FXD COMP 47 OHM 10% 1/2W | 01121 | EB 4701 |
| A1R5 | 0757-0470 | 1 | R:FXD MET FLM 162K OHM 1% 1/8W | 28480 | 0757-0470 |
| A1R6 | 0684-3331 | 1 | R:FXD COMP 33K OHM 10% 1/4W | 01121 | CB 3331 |
| A1R7 | 0684-4721 | 1 | R:FXD COMP 4700 OHM 10% 1/4W | 01121 | CB 4721 |
| A1R8 | 0687-2711 | 1 | R:FXD COMP 270 OHM +/-10% 1/2W | 01121 | EB 2711 |
| A1R9 | 0698-3605 | 1 | R:FXD MET OX 15 OHM 5% 2W | 28480 | 0698-3605 |
| A1VR1 | 1902-0026 | 1 | DIODE BREAKDOWN:36.5V 10% | 28480 | 1902-0026 |
| A2 | 00197-66504 | 1 | TIMING CIRCUIT BOARD ASSY | 28480 | 00197-66504 |
| A2C1 | 0150-0023 | 1 | C:FXD CER 2000 PF 20% 1000VDCW | 56289 | 20C295A2-CDH |
| A2C2 | 0160-0168 | 1 | C:FXD MY 0.1 UF 10% 200VDCW | 56289 | 192P10492-PTS |
| A2C3 | 0160-3451 | 2 | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-CDH |
| A2C4 | 0160-3451 | | C:FXD CER 0.01 UF +80-20% 100VDCW | 56289 | C023B101F103ZS25-CDH |
| A2C5 | 0160-0820 | 1 | C:FXD CER 0.05 UF +80-20% 25VDCW | 72982 | 5855 Y5U 503Z |
| A2C6 | 0180-0116 | 1 | C:FXD TA ELECT 6.8UF 10% 25VDCW | 56289 | 150D685X9035B2-DYS |
| A2C7 | 0180-2358 | 1 | C:FXD TANT 150 UF 5% 6VDCW | 56289 | 150D157X5006R2 |
| A2CR1 | 1910-0016 | 2 | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A2CR2 | 1910-0016 | | DIODE:GERMANIUM 100MA/0.85V 60PIV | 93332 | D2361 |
| A2MP1 | | | DELETED | | |
| A2MP2 | | | DELETED | | |
| A2MP3 | 01840-22502 | 1 | ROLLER:DETENT | 28480 | 01840-22502 |
| A2Q1 | 1854-0071 | | TSTR:SI NPN(SELECTED FROM 2N3704) | 28480 | 1854-0071 |
| A2Q2 | 1854-0053 | | TSTR:SI NPN | 80131 | 2N2218 |
| A2R1 | 0684-1001 | 1 | R:FXD COMP 10 OHM 10% 1/4W | 01121 | CB 1001 |
| A2R2 | 0684-1051 | 1 | R:FXD COMP 1 MEGOHM 1% 1/4W | 01121 | CB 1051 |
| A2R3 | 0757-0472 | 1 | R:FXD MET FLM 200K OHM 1% 1/8W | 28480 | 0757-0472 |
| A2R4 | 0761-0037 | | R:FXD MET OX 390 OHM 5% 1W | 28480 | 0761-0037 |
| A2U1 | 1810-0220 | 1 | RESISTIVE NETWORK: THIN FILM | 28480 | 1810-0220 |
| A2U2 | 1820-0261 | 1 | IC:TTL MONOSTABLE MULTIVIBRATOR | 01295 | SN74121N |
| A2VR1 | 1902-3104 | 1 | DIODE:BREAKDOWN 5.62V 5% | 04713 | SZ10939-110 |
| A2XU2 | 1200-0441 | 1 | SOCKET:IC 14 PIN MINIATURE | 28480 | 1200-0441 |

See introduction to this section for ordering information

*Table 6-2. Replaceable Parts*

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| A1 | 00195-66505 | | OUTPUT CIRCUIT BOARD ASSY | 28480 | 00195-66505 |
| A2 | 00197-66504 | | TIMING CIRCUIT BOARD ASSY | 28480 | 00197-66504 |
| F1 | 2110-0064 | 1 | F: 0.125 A 125V SLO-BLO | 28480 | 2110-0064 |
| F1 | 2110-0311 | 1 | F: 0.062 A 250V SLO-BLO | 71400 | MDL-1/16 |
| H1 | 2200-0159 | 17 | SCREW-MACH 4-40 .25-IN-LG 82-DEG FL-HD | 28480 | 2200-0159 |
| H2 | 2260-0002 | 12 | NUT-HEX-DBL CHAM 4-40 THD .062 THK | 28480 | 2260-0002 |
| H3 | 0624-0073 | 4 | SCREW-TPG 6-32 .312-IN-LG PAN-HD | 28480 | 0624-0073 |
| H4 | 0624-0074 | 4 | SCREW-TPG 6-32 .375-IN-LG PAN-HD | 28480 | 0624-0074 |
| H5 | 0510-0956 | 2 | RING: RETAINING 0.188-IN SHAFT | 79136 | 5133-18-MD |
| H6 | 2510-0118 | 2 | SCREW-MACH 8-32 100-DEG FL-HD | 28480 | 2510-0118 |
| H7 | 0520-0161 | 4 | SCREW-MACH 2-56 .312-IN-LG 82-DEG FL-HD | 28480 | 0520-0161 |
| H8 | 2200-0157 | 1 | SCREW-MACH 4-40 .438-IN-LG FIL-HD | 28480 | 2200-0157 |
| H9 | 3050-0105 | 6 | WASHER-FL MTLC NO. 4 .125-IN-ID .281-IN-OD | 28480 | 3050-0105 |
| H10 | 2190-0030 | 8 | WASHER-LK HLCL NO. 4 .115-IN-ID .173-IN-OD | 28480 | 2190-0030 |
| H11 | 3050-0002 | 1 | WASHER-FL MTLC NO. 10 .203-IN-ID .438-IN-OD | 28480 | 3050-0002 |
| H12 | 2200-0165 | 4 | SCREW-MACH 4-40 .25-IN-LG 82-DEG FL-HD | 28480 | 2200-0165 |
| H13 | 0510-0015 | 1 | RETAINER, RING, .125 DIA, CAD PLT STL | 79136 | 5133-12-S-MD-R |
| H14 | 2200-0160 | 10 | SCREW-MACH 4-40 .125-IN-LG PAN-HD | 28480 | 2200-0160 |
| H15 | 0520-0160 | 4 | SCREW-MACH 2-56 .25-IN-LG 82-DEG FL-HD | 28480 | 0520-0160 |
| H16 | 2200-0151 | 1 | SCREW-MACH 4-40 .75-IN-LG PAN-HD | 28480 | 2200-0151 |
| H17 | 3050-0066 | 1 | WASHER-FL MTLC NO. 6 .147-IN-ID .375-IN-OD | 28480 | 3050-0066 |
| H18 | 2190-0018 | 11 | WASHER-LK HLCL NO. 6 .141-IN-ID .269-IN-OD | 28480 | 2190-0018 |
| H19 | 2260-0001 | 6 | NUT-HEX-DBL CHAM 4-40 THD .094-THK | 28480 | 2260-0001 |
| H20 | 2200-0143 | 1 | SCREW-MACH 4-40 .375-IN-LG PAN-HD | 28480 | 2200-0143 |
| H21 | 2190-0037 | 1 | WASHER-LK INTL T NO. 1/2 .512-IN-ID .789-IN-OD | 78189 | 1224-08 |
| H22 | 2200-0155 | 2 | SCREW-MACH 4-40 1-IN-LG PAN-HD | 28480 | 2200-0155 |
| H23 | 2360-0292 | 10 | SCREW-MACH 6-32 .312-IN-LG 100-DEG FL HD | 28480 | 2360-0292 |
| H24 | 2360-0003 | 8 | SCREW-MACH 6-32 .25-IN-LG RD-HD | 28480 | 2360-0003 |
| H25 | 2360-0113 | 6 | SCREW-MACH 6-32 .25-IN-LG PAN-HD | 28480 | 2360-0113 |
| H26 | 2200-0155 | 2 | SCREW-MACH 4-40 1-IN-LG PAN-HD | 28480 | 2200-0155 |
| H27 | 2190-0469 | 3 | WASHER-LK INTL T NO. 4 .116-IN-ID .265-IN-OD | 78189 | 1704-00-00-4012 |
| H28 | 2200-0170 | 8 | SCREW-MACH 4-40 .625-IN-LG 82-DEG FL-HD | 28480 | 2200-0170 |
| H29 | 2950-0006 | 8 | NUT-HEX-DBL CHAM 1/4-32-THD .094-THK | 73734 | 9000 |
| H30 | 0360-1251 | 5 | TERMINAL, SLDR LUG, 12 SCR, .25/.085 ID | 79963 | 7A-H-1/4 |
| H31 | 3030-0253 | 2 | SCREW-SKT HD CAP 4-40 .25-IN-LG HEX-REC | 28480 | 3030-0253 |
| H32 | 0510-0166 | 1 | RETAINER, RING, .156 DIA, CAD PLT STL | 97464 | 1000-15-ST-CD |
| H33 | 0510-0715 | 1 | RETAINER, RING, .188 DIA, CAD PLT STL | 97464 | 1001-18-ST-CD |
| H34 | 0510-0091 | 2 | RETAINER, RING, .25 DIA, CAD PLT STL | 97464 | 2000-25-ST-CD |
| H35 | 0380-0022 | 2 | SPACER-RND .375-LG .128-ID .19 OD STL | 76854 | 3457-424 |
| H36 | 0380-0411 | 3 | SPACER-RND .5-LG .114-ID .154 OD STL | 76854 | 8980-432 |
| H37 | 1480-0012 | 1 | PIN-ROL. .078-BY- .250 IN | 28480 | 1480-0012 |
| H38 | 1480-0310 | 1 | PIN-GRV .062-BY- .438 IN | 28480 | 1480-0310 |
| H39 | 2200-0163 | 3 | SCREW-MACH 4-40 .375-IN-LG TR-HD SLT-REC | 28480 | 2200-0163 |
| H40 | 2200-0139 | 10 | SCREW-MACH 4-40 .25-IN-LG PAN-HD | 28480 | 2200-0139 |
| H41 | 2360-0178 | 2 | SCREW-MACH 6-32 .125-IN-LG BDG-HD | 28480 | 2360-0178 |
| H42 | 2680-0115 | 2 | SCREW-MACH 10-32 .375-IN-LG 100-DEG | 28480 | 2680-0115 |
| H43 | 3050-0179 | 2 | WASHER-FL MTLC NO. 10 .203-IN-ID .75-IN-OD | 28480 | 3050-0179 |
| H44 | 2190-0011 | 2 | WASHER-LK INTL T NO. 10 .195-IN-ID .381-IN-OD | 78189 | 1910-00 |
| H45 | 2820-0002 | 2 | NUT-HEX-DBL CHAM 10-32-THD .094-THK | 28480 | 2820-0002 |
| H46 | 2200-0720 | 6 | SCREW-MACH 4-40 .188-IN-LG 82-DEG FL-HD | 28480 | 2200-0720 |
| H47 | 2200-0752 | 2 | SCREW-MACH 4-40 .125-IN-LG 82-DEG FL-HD | 28480 | 2200-0752 |
| H48 | 2360-0179 | 2 | SCREW-MACH 6-32 .625-IN-LG BDG-HD | 28480 | 2360-0179 |
| J1 | 1251-4068 | 2 | CONNECTOR:BANANA JACK | 28480 | 1251-4068 |
| J2 | 1251-4068 | | CONNECTOR:BANANA JACK | 28480 | 1251-4068 |
| J3 | | | NSR:PART OF MP11 | | |
| L1 | 5080-0471 | 1 | SOLENOID:ROTARY | 28480 | 5080-0471 |
| MP1 | 4320-0019 | 1 | MASK:FACE | 28480 | 4320-0019 |
| MP2 | 00197-44101 | 1 | COVER:END, HOOD TOP | 28480 | 00197-44101 |
| MP3 | 00197-44102 | 1 | COVER:END, HOOD BOTTOM | 28480 | 00197-44102 |
| MP4 | 00197-44901 | 1 | DOOR:VIEWING HOOD | 28480 | 00197-44901 |
| MP5 | 1460-0279 | 1 | SPRING:TORSION | 00000 | OBD |
| MP6 | 00195-00101 | 1 | HOOD:VIEWING, OLIVE GRAY | 28480 | 00195-00101 |
| MP6 | 00197-00101 | 1 | HOOD:VIEWING, BLUE GRAY (OPT X95) | 28480 | 00197-00101 |
| MP7 | 1440-0035 | 1 | HANDLE:CARRYING 7-13/16" LG | 12136 | 7835-SPECIAL |
| MP8 | 00197-44702 | 1 | SEAL:LIGHT | 28480 | 00197-44702 |
| MP9 | 00197-01207 | 1 | BRACKET:HOOD FRONT | 28480 | 00197-01207 |
| MP10 | 00195-01201 | 1 | BRACKET:HOOD REAR | 28480 | 00195-01201 |
| MP11 | 00197-64101 | 1 | COVER:LEFT SIDE: OLIVE GRAY (INCLUDES J3) | 28480 | 00197-64101 |
| MP11 | 00197-64102 | 1 | COVER:LEFT SIDE: BLUE-GRAY OPTION X95 (INCLUDES J3) | 28480 | 00197-64102 |
| MP12 | 00197-01209 | 1 | BRACKET:MOUNTING | 28480 | 00197-01209 |
| MP13 | 00197-04107 | 1 | CUSHION, FELT, T-SHAPE (USED ON MP36) | 28480 | 00197-04107 |
| MP14 | 9300-0081 | 4 FT | RIBBON-VELVET (USED ON MP39) | 28480 | 9300-0081 |
| MP15 | 9300-0070 | 1 FT | RIBBON-VELVET (USED ON MP41) | 28480 | 9300-0070 |
| MP16 | 00195-04110 | 1 | COVER:OUTPUT BOARD | 28480 | 00195-04110 |
| MP17 | 00197-69502 | 1 | FRAME:MOUNTING | 28480 | 00197-69502 |
| MP18 | 00197-27401 | 1 | BUTTON:LATCH | 28480 | 00197-27401 |
| MP19 | 1460-0278 | 1 | SPRING:COMPRESSION 0.560" LG | 00000 | OBD |
| MP20 | 00197-25001 | 1 | LATCH:SWING AWAY | 28480 | 00197-25001 |
| MP21 | 0370-0190 | 1 | KNOB:ROUND BLACK 0.187" DIA SHAFT | 28480 | 0370-0190 |
| MP22 | 00197-23704 | 1 | SHAFT:MOUNTING LOCK | 28480 | 00197-23704 |

*Table 6-2. Replaceable Parts (Cont'd)*

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| MP23 | 00197-22408 | 1 | GEAR:WORM | 28480 | 00197-22408 |
| MP24 | 00197-22410 | 1 | GEAR:WORM 48 PITCH | 28480 | 00197-22410 |
| MP25 | 00197-69503 | 1 | LEVER:MOUNTING LOCK | 28480 | 00197-69503 |
| MP26 | 00197-04701 | 1 | GASKET:MOUNTING | 28480 | 00197-04701 |
| MP27 | 00197-01205 | 1 | RETAINER:MOUNTING, LEFT HAND | 28480 | 00197-01205 |
| MP28 | 00197-01206 | 1 | RETAINER:MOUNTING, RIGHT HAND | 28480 | 00197-01206 |
| MP29 | 00197-04801 | 2 | WIPER:MOUNT | 28480 | 00197-04801 |
| MP30 | 00197-04702 | 1 | GASKET:WIPER, LEFT HAND | 28480 | 00197-04702 |
| MP31 | 00197-04704 | 1 | GASKET:WIPER, RIGHT HAND | 28480 | 00197-04704 |
| MP32 | 00197-05101 | 1 | HINGE:SWING AWAY | 28480 | 00197-05101 |
| MP33 | 00197-62002 | 1 | ASSY:FRAME FRONT | 28480 | 00197-62002 |
| MP34 | 00197-62001 | 1 | ASSY:FRAME REAR | 28480 | 00197-62001 |
| MP35 | 00197-20501 | 2 | TRIM:CAMERA | 28480 | 00197-20501 |
| MP36 | 00197-00105 | 1 | PLATE:BOTTOM | 28480 | 00197-00105 |
| MP37 | 00197-60601 | 1 | ASSY:BELLOWS | 28480 | 00197-60601 |
| MP38 | 00197-40601 | 1 | SEAL:LIGHT | 28480 | 00197-40601 |
| MP39 | 00197-22001 | 1 | PLATE:DETENT | 28480 | 00197-22001 |
| MP40 | 00197-64301 | 1 | ASSY:DETENT | 28480 | 00197-64301 |
| MP41 | 00197-09101 | 4 | SPRING:LEFT DETENT | 28480 | 00197-09101 |
| MP42 | 00197-05002 | 1 | LATCH:DETENT | 28480 | 00197-05002 |
| MP43 | 0370-0918 | 1 | BUTTON:DETENT | 28480 | 0370-0918 |
| MP44 | 1460-0277 | 1 | WIREFORM | 00000 | OBD |
| MP45 | 10353-60001 | 1 | ASSY:CAMERA BACK | 28480 | 10353-60001 |
| MP46 | 00197-64701 | 1 | ASSY:SHUTTER BOARD | 28480 | 00197-64701 |
| MP47 | 00197-41703 | 2 | SUPPORT:FRONT | 28480 | 00197-41703 |
| MP48 | 00197-23702 | 2 | SHAFT:CARRIAGE | 28480 | 00197-23702 |
| MP49 | 00197-41704 | 1 | SUPPORT LEFT HAND REAR | 28480 | 00197-41704 |
| MP50 | 00197-41705 | 1 | SUPPORT:RIGHT HAND REAR | 28480 | 00197-41705 |
| MP51 | 00197-22403 | 2 | GEAR:CARRIAGE DRIVE | 28480 | 00197-22403 |
| MP52 | 00197-23705 | 1 | SHAFT:CARRIAGE LOCK | 28480 | 00197-23705 |
| MP53 | 00197-41204 | 1 | CLAMP:CARRIAGE LOCK | 28480 | 00197-41204 |
| MP54 | 00197-22407 | 1 | SCREW:CARRIAGE CLAMP | 28480 | 00197-22407 |
| MP55 | 0570-0164 | 1 | SCREW:REDUCTION RATIO | 00000 | OBD |
| MP56 | 00197-48801 | 1 | GROMMET | 28480 | 00197-48801 |
| MP57 | 00197-04106 | 1 | COVER:BOTTOM | 28480 | 00197-04106 |
| MP58 | 1000-0226 | 1 | PLATE:FOCUS | 28480 | 1000-0226 |
| MP59 | | | DELETED | | |
| MP60 | | | DELETED | | |
| MP61 | | | DELETED | | |
| MP62 | 00197-04111 | 1 | COVER:RIGHT SIDE, BLUE GRAY (OPT X95) | 28480 | 00197-04111 |
| MP62 | 00197-04115 | 1 | COVER:RIGHT SIDE, OLIVE GRAY | 28480 | 00197-04115 |
| MP63 | 00197-01208 | 1 | BRACKET:FRONT MOUNTING, RIGHT SIDE | 28480 | 00197-01208 |
| MP64 | 00197-01210 | 1 | BRACKET:PINION | 28480 | 00197-01210 |
| MP65 | 00197-04703 | 1 | SUPPORT:PINION | 28480 | 00197-04703 |
| MP66 | 0400-0068 | 1 | BUSHING:SNAP-IN FOR 1/4" DIA SHAFT | 96881 | 4L1-FF |
| MP67 | 00197-01201 | 1 | BRACKET:GEAR | 28480 | 00197-01201 |
| MP68 | 0400-0067 | 3 | BUSHING:SNAP-IN FOR 3/16" DIA SHAFT | 96881 | 3L1-FF |
| MP69 | 00197-22405 | 1 | SHAFT:SPLINED | 28480 | 00197-22405 |
| MP70 | 00197-22401 | 1 | GEAR:PINION | 28480 | 00197-22401 |
| MP71 | 00197-23701 | 1 | SHAFT:F-DRIVE | 28480 | 00197-23701 |
| MP72 | 00197-22402 | 1 | GEAR:BEVEL | 28480 | 00197-22402 |
| MP73 | 00197-01202 | 2 | BRACKET:BEZEL RETAINER | 28480 | 00197-01202 |
| MP74 | 00197-04113 | 1 | COVER:TIMING BOARD | 28480 | 00197-04113 |
| MP75 | 00197-00206 | 1 | PANEL:CONTROL | 28480 | 00197-00206 |
| MP76 | 00197-22201 | 1 | BEZEL:CONTROL PANEL | 28480 | 00197-22201 |
| MP77 | | | DELETED | | |
| MP78 | 00197-47402 | 1 | LEVER:SHUTTER RELEASE | 28480 | 00197-47402 |
| MP79 | 0370-0133 | 1 | KNOB:SKIRTED FOR 0.250" DIA SHAFT | 28480 | 0370-0133 |
| MP80 | 0370-0077 | 1 | KNOB:SKIRTED BAR FOR 0.250" DIA SHAFT | 28480 | 0370-0077 |
| MP81 | 00197-27402 | 1 | KNOB:FOCUS | 28480 | 00197-27402 |
| MP82 | 00197-65001 | 1 | LOCK:FOCUS | 28480 | 00197-65001 |
| MP83 | 00197-47401 | 1 | BUTTON:FOCUS LOCK | 28480 | 00197-47401 |
| MP84 | 00197-69501 | 1 | ASSY:SHUTTER AND IRIS (INCLUDES L1) | 28480 | 00197-69501 |
| MP85 | 00197-22005 | 1 | COVER:SHUTTER SOLENOID | 28480 | 00197-22005 |
| MP86 | 00197-22404 | 1 | GEAR:IDLER | 28480 | 00197-22404 |
| MP87 | 00197-21702 | 1 | BUSHING:GEAR | 28480 | 00197-21702 |
| MP88 | 1000-0702 | 1 | LENS:F/1.9 75 MM | 28480 | 1000-0702 |
| MP89 | | | DELETED | | |
| MP90 | | | DELETED | | |
| MP91 | | | DELETED | | |
| MP92 | | | DELETED | | |
| MP93 | 00197-41002 | 1 | FOOT:CENTER | 28480 | 00197-41002 |
| MP94 | 00197-41004 | 1 | FOOT:LEFT | 28480 | 00197-41004 |
| MP95 | 00197-41003 | 1 | FOOT:RIGHT | 28480 | 00197-41003 |
| MP96 | 00197-41001 | 1 | FOOT:LEVER | 28480 | 00197-41001 |
| MP97 | 00197-00207 | 1 | PANEL:SUB-POWER | 28480 | 00197-00207 |
| MP98 | 5020-0568 | 1 | RETAINER:MOUNTING, FOR OPTIONAL USE WITH HP 180-SERIES RECTANGULAR OSCILLOSCOPE BEZELS, REPLACES MP27 AND MP28. | 28480 | 5020-0568 |
| MP99 | 00197-23707 | 1 | SHAFT:CAMERA SW | 28480 | 00197-23707 |
| MP100 | | | DELETED | | |
| MP101 | 3130-1390 | 1 | ROTOR ASSY:MALE | 28480 | 3130-1390 |

See introduction to this section for ordering information

*Table 6-2. Replaceable Parts (Cont'd)*

| Reference Designation | HP Part Number | Qty | Description | Mfr Code | Mfr Part Number |
|---|---|---|---|---|---|
| MP102 | 3130-1391 | 1 | ROTOR ASSY:FEMALE | 28480 | 3130-1391 |
| MP103 | 0510-1101 | 1 | RING:RETAINING FOR MP101 AND MP102 | 28480 | 0510-1101 |
| S1 | 3101-0200 | 1 | SWITCH:SENSITIVE SPOT MINIATURE (SHUTTER) | 95146 | V3-15 |
| S2 | 00197-44801 | 1 | SWITCH:SYNC CONTACT | 28480 | 00197-44801 |
| T1 | 9100-3269 | 1 | TRANSFORMER:POWER | 28480 | 9100-3269 |
| W1 | 8120-1348 | 1 | CABLE ASSY:POWER, DETACHABLE | 28480 | 8120-1348 |
| W1P1 | | | NSR PART OF W1 | | |
| W1P2 | | | NSR PART OF W1 | | |
| W2 | 00197-61605 | 1 | CABLE RIBBON | 28480 | 00197-61605 |
| XF1 | 1400-0084 | 1 | FUSEHOLDER:EXTRACTOR POST TYPE | 75915 | 342014 |

## Table 6-3. List of Manufacturers' Codes

| MFR NO. | MANUFACTURER NAME | ADDRESS | ZIP CODE |
|---|---|---|---|
| | NO M/F DESCRIPTION FOR THIS MFG NUMBER | | |
| 00000 | U.S.A. COMMON | ANY SUPPLIER OF U.S.A. | |
| 01121 | ALLEN BRADLEY CO. | MILWAUKEE, WIS. | 53204 |
| 01295 | TEXAS INSTRUMENTS INC. SEMICONDUCTOR COMPONENTS DIV. | DALLAS, TEX. | 75231 |
| 04713 | MOTOROLA SEMICONDUCTOR PROD.INC. | PHOENIX, ARIZ. | 85008 |
| 08806 | G.E. CO. MINIATURE LAMP DEPT. | CLEVELAND, OHIO | 44112 |
| 12136 | PHILADELPHIA HANDLE CO. | CAMDEN, N.J. | 08103 |
| 28480 | HEWLETT-PACKARD COMPANY | PALO ALTO, CALIF. | 94304 |
| 56289 | SPRAGUE ELECTRIC CO. | N. ADAMS, MASS. | 01247 |
| 70903 | BELDEN CORP. | CHICAGO, ILL. | 60644 |
| 71041 | BOSTON GEAR WORKS DIV N. AMERICAN ROCKWELL CORP. | QUINCY, MASS. | 02171 |
| 72765 | DRAKE MFG. CO. | HARWOOD HEIGHTS, ILL. | 60656 |
| 72982 | ERIE TECHNOLOGICAL PROD. INC. | ERIE, PA. | 16512 |
| 75915 | LITTELFUSE INC. | DES PLAINES, ILL. | 60016 |
| 79727 | CONTINENTAL-WIRT ELECTRONICS CORP. | PHILADELPHIA, PA. | 19144 |
| 80131 | ELECTRONIC INDUSTRIES ASSOCIATION | WASHINGTON D.C. | 20006 |
| 82389 | SWITCHCRAFT INC. | CHICAGO, ILL. | 60630 |
| 83330 | SMITH HERMAN H. INC. | BROOKLYN, N.Y. | 11207 |
| 93332 | SYLVANIA ELECTRIC PROD. INC. SEMICONDUCTOR DIV. | WOBURN, MASS. | 01801 |
| 95145 | ALCO ELECT. PROD. INC. | LAWRENCE, MASS. | 01843 |
| 96881 | THOMSON IND. INC. | MANHASSET, N.Y. | 11030 |

# SECTION VII

# MANUAL CHANGES

## 7-1. INTRODUCTION.

7-2. This section contains information required to backdate this manual for a specific instrument. Descriptions of special and selected standard options are also provided in this section.

## 7-3. MANUAL CHANGES.

*Table 7-1. Manual Changes*

| Serial Prefix | Make Changes |
|---|---|
| 610- | 1, 2, 3, 4, 5 |
| 730- | 2, 3, 4, 5 |
| 805- | 3, 4, 5 |
| 905- | 4, 5 |
| 913- | 4, 5 |
| 1203- | 5 |

7-4. This manual applies directly to the instrument having the same serial prefix shown on the manual title page. If the serial prefix of the instrument is not the same as the one on the title page, find your serial prefix in table 7-1 and make the changes to the manual that are listed for that serial prefix. When making changes listed in table 7-1, make the changes with the highest number first. Example: if backdating changes 1, 2, and 3 are required for your serial prefix, do change 3 first, then change 2, and finally change 1. If the serial prefix of the instrument is not listed either on the title page or in table 7-1, refer to the enclosed MANUAL CHANGES sheet for updating information. Also, if a MANUAL CHANGES sheet is supplied, make all indicated ERRATA corrections.

## 7-5. OPTION 012 WIRING DIAGRAM CHANGE.

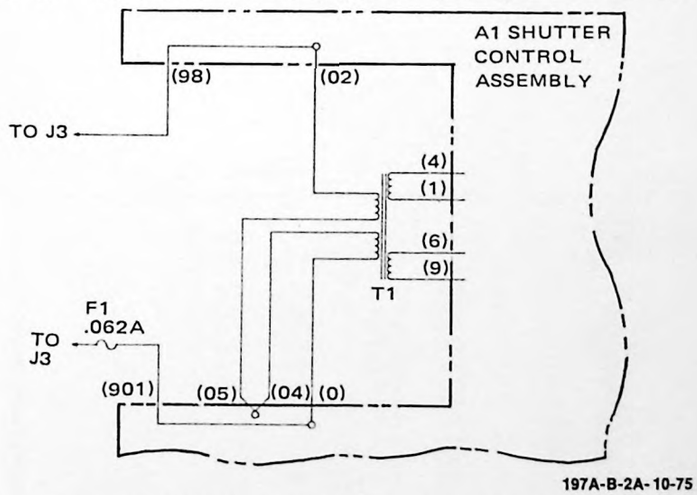



*Figure 7-1. Option 012 Wiring and Fuse Changes*

7-6. Option 012 provides a standard instrument with the power input circuit wired for 230 volts ac operation. If you have ordered a Model 197A/Option 012, see figure 7-1 for wiring and fuse changes.

## 7-7. MANUAL CHANGES LISTING.

### CHANGE 1

Table 7-2,
Delete: R2.
V1: Change to HP Part No. 2140-0064, V:FLUORESCENT ULTRAVIOLET 2W.
Delete: MP91 and MP92.
Figure 7-3,
Delete: R2. Make straight-through connection.

### CHANGE 2

Table 7-2,
Delete: CR10 and CR40.
Q11: Change to HP Part No. 1853-0036, Q:SI PNP.
Q41: Change to HP Part No. 1853-0036, Q:SI PNP.
Figure 7-3,
Delete: CR10 and CR40.

### CHANGE 3

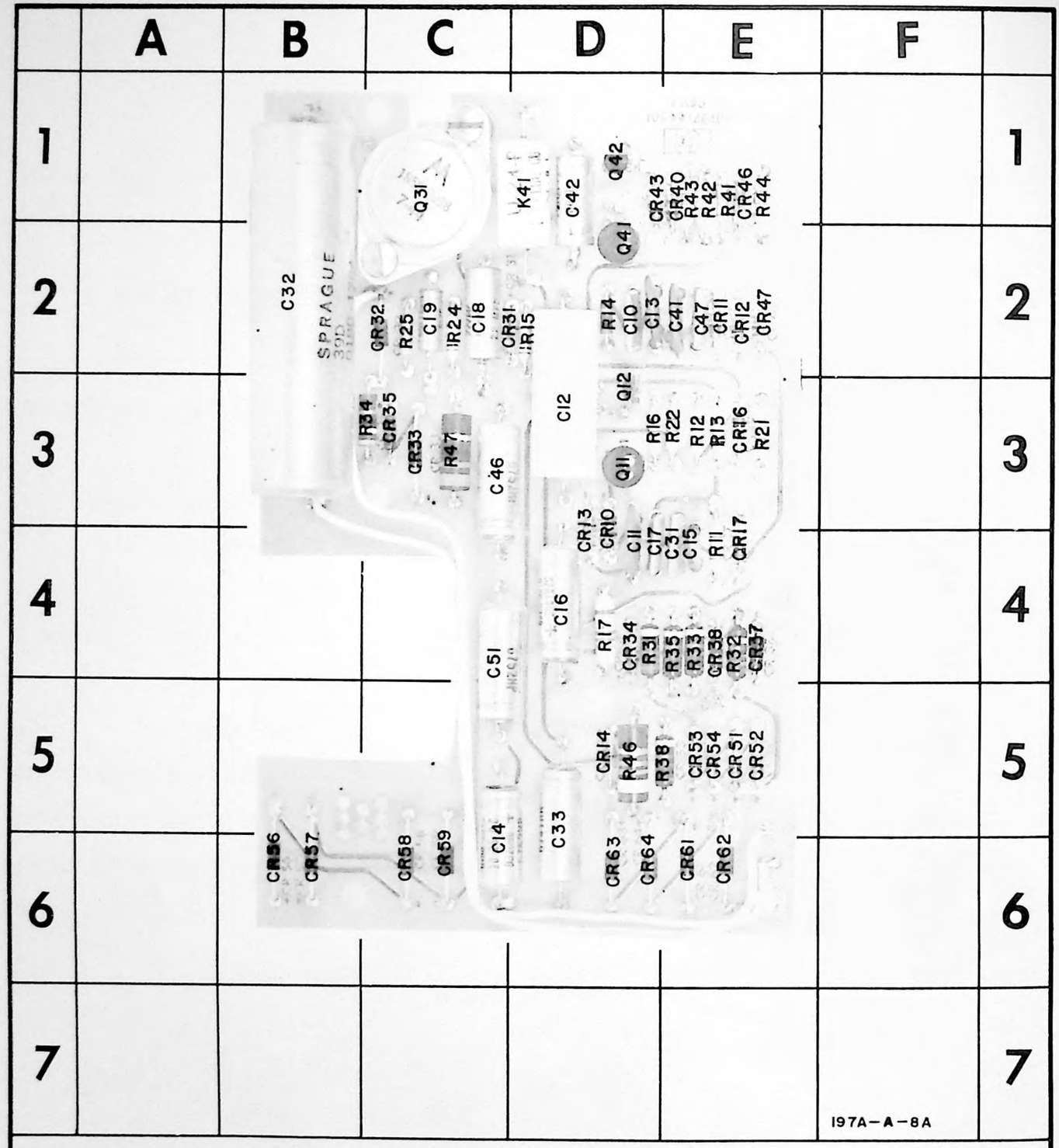
Table 7-2,
MP11: Change to HP Part No. 00197-04112, COVER: CAMERA L. H.
Add: MP13, HP Part No. 00197-01213, BRACKET, FRONT MOUNTING L. H.
MP15: Change to HP Part No. 0380-0007, SPACER: COVER PC BOARD.
MP62: Change to HP Part No. 00197-04104, COVER: CAMERA R. H.

### CHANGE 4

Table 6-2,
Replace with table 7-2.
Figures 8-1 and 8-2,
Replace with figure 7-2.
Figure 8-3,
Replace with figure 7-3.

### CHANGE 5

Page 1-1, paragraph 1-11,
Add the following: OPTION 001. This option is a standard instrument with the graticule illumination feature omitted.
Figure 6-1,
Replace with figure 7-4.
Table 6-2,
MP36: Change HP Part No. and Mfr Part No. to 00197-00102; description unchanged.




| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C10 | D-2 | C32 | B-2 | CR14 | D-5 | CR43 | D-1 | CR61 | E-6 | R12 | E-3 | R32 | E-4 |
| C11 | D-3 | C33 | D-5 | CR16 | E-3 | CR46 | E-1 | CR62 | E-6 | R13 | E-3 | R33 | E-4 |
| C12 | D-2 | C41 | E-2 | CR17 | E-3 | CR47 | E-2 | CR63 | D-6 | R14 | D-2 | R34 | B-3 |
| C13 | D-2 | C42 | D-1 | CR31 | C-2 | CR51 | E-4 | CR64 | D-6 | R15 | D-2 | R35 | B-4 |
| C14 | B-6 | C46 | C-3 | CR32 | B-2 | CR52 | E-4 | K41 | C-1 | R16 | D-3 | R38 | E-6 |
| C15 | E-3 | C47 | E-2 | CR33 | C-3 | CR53 | E-4 | Q11 | D-3 | R17 | D-4 | R41 | E-1 |
| C16 | D-4 | C51 | C-4 | CR34 | D-5 | CR54 | E-4 | Q12 | D-2 | R21 | E-3 | R42 | E-1 |
| C17 | D-3 | CR10 | D-4 | CR35 | C-3 | CR56 | B-6 | Q31 | C-1 | R22 | E-3 | R43 | E-1 |
| C18 | C-2 | CR11 | E-2 | CR37 | E-4 | CR57 | C-6 | Q41 | D-1 | R24 | C-2 | R44 | E-1 |
| C19 | C-2 | CR12 | E-2 | CR38 | E-4 | CR58 | C-6 | Q42 | D-1 | R25 | C-2 | R46 | D-5 |
| C31 | E-3 | CR13 | D-3 | CR40 | E-1 | CR59 | E-6 | R11 | E-3 | R31 | D-4 | R47 | C-3 |

*Figure 7-2. Shutter Control Component Identification*

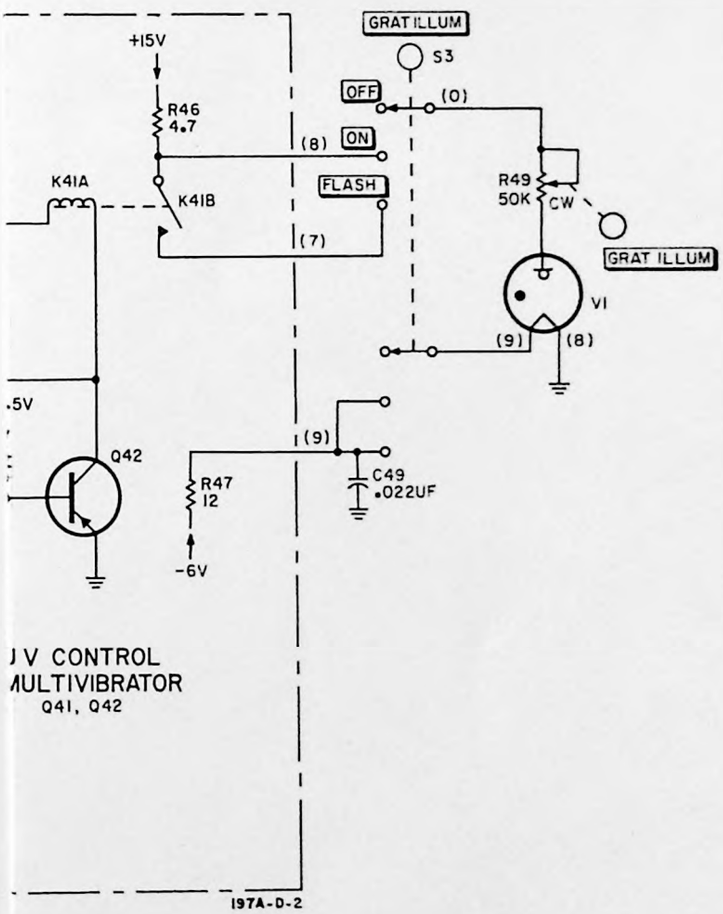



*Figure 7-3.*
*Shutter Control Schematic*

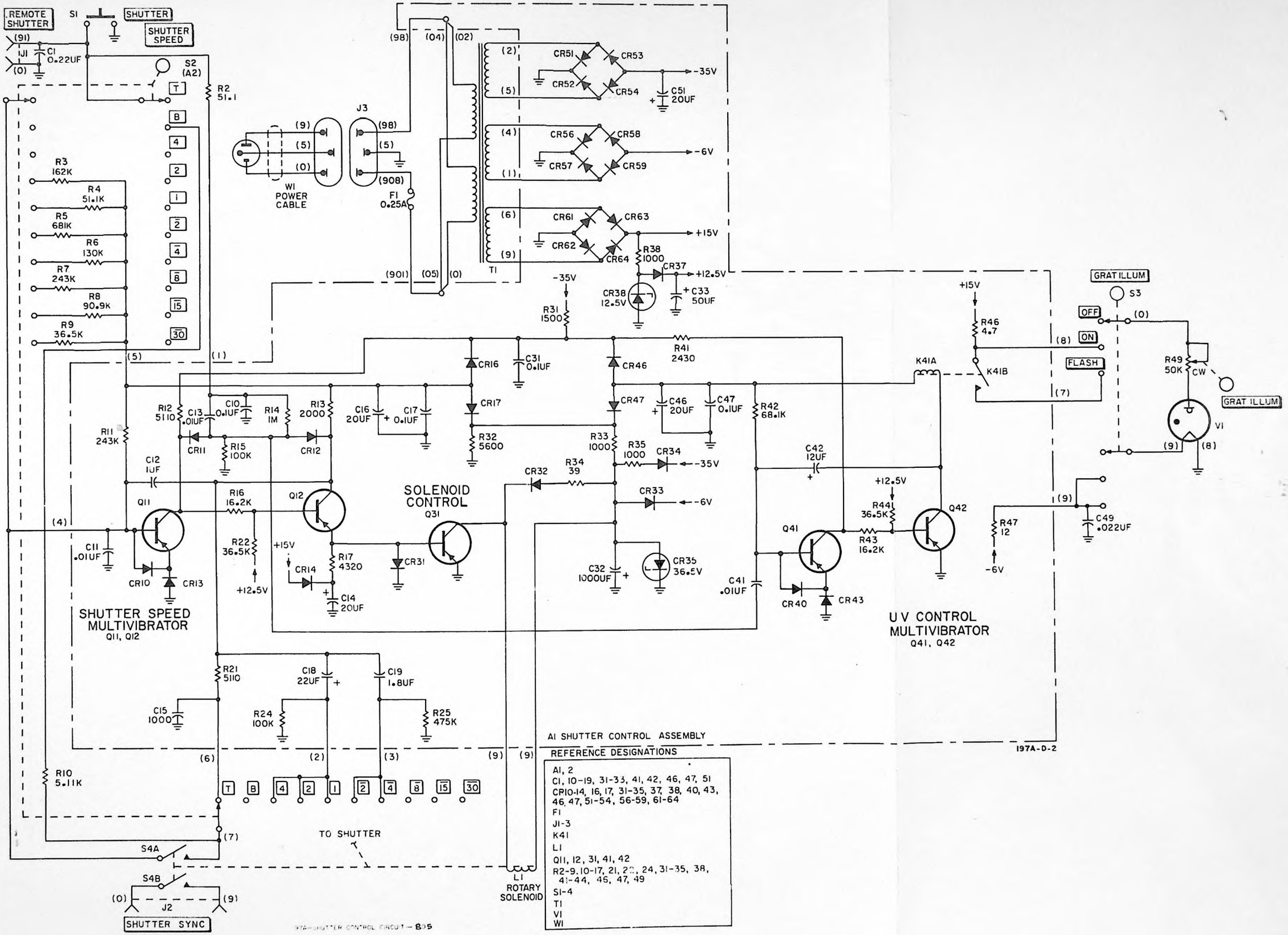



*Figure 7-3.*
*Shutter Control Schematic*

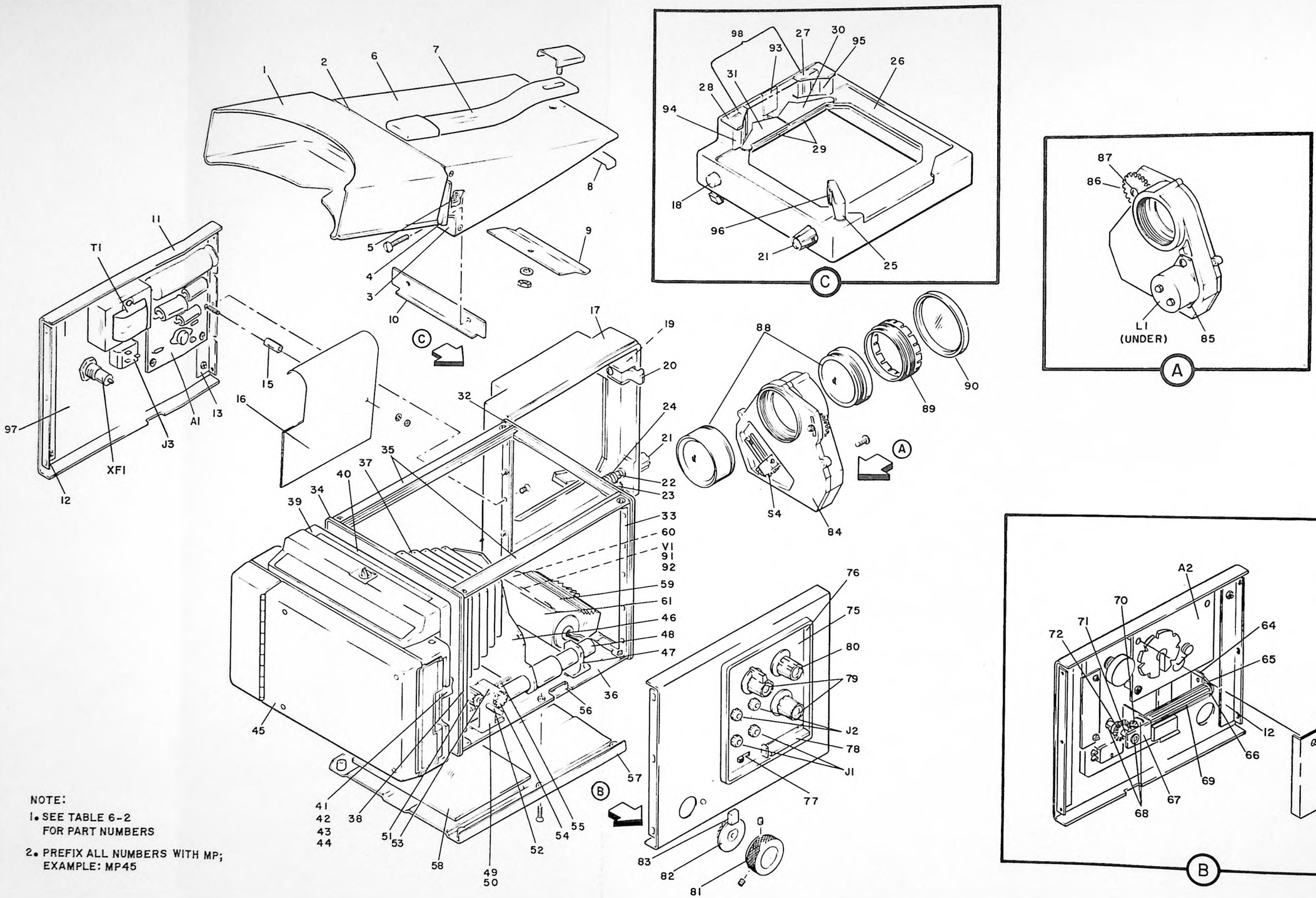



*Figure 7-4. Model 197A Exploded View*

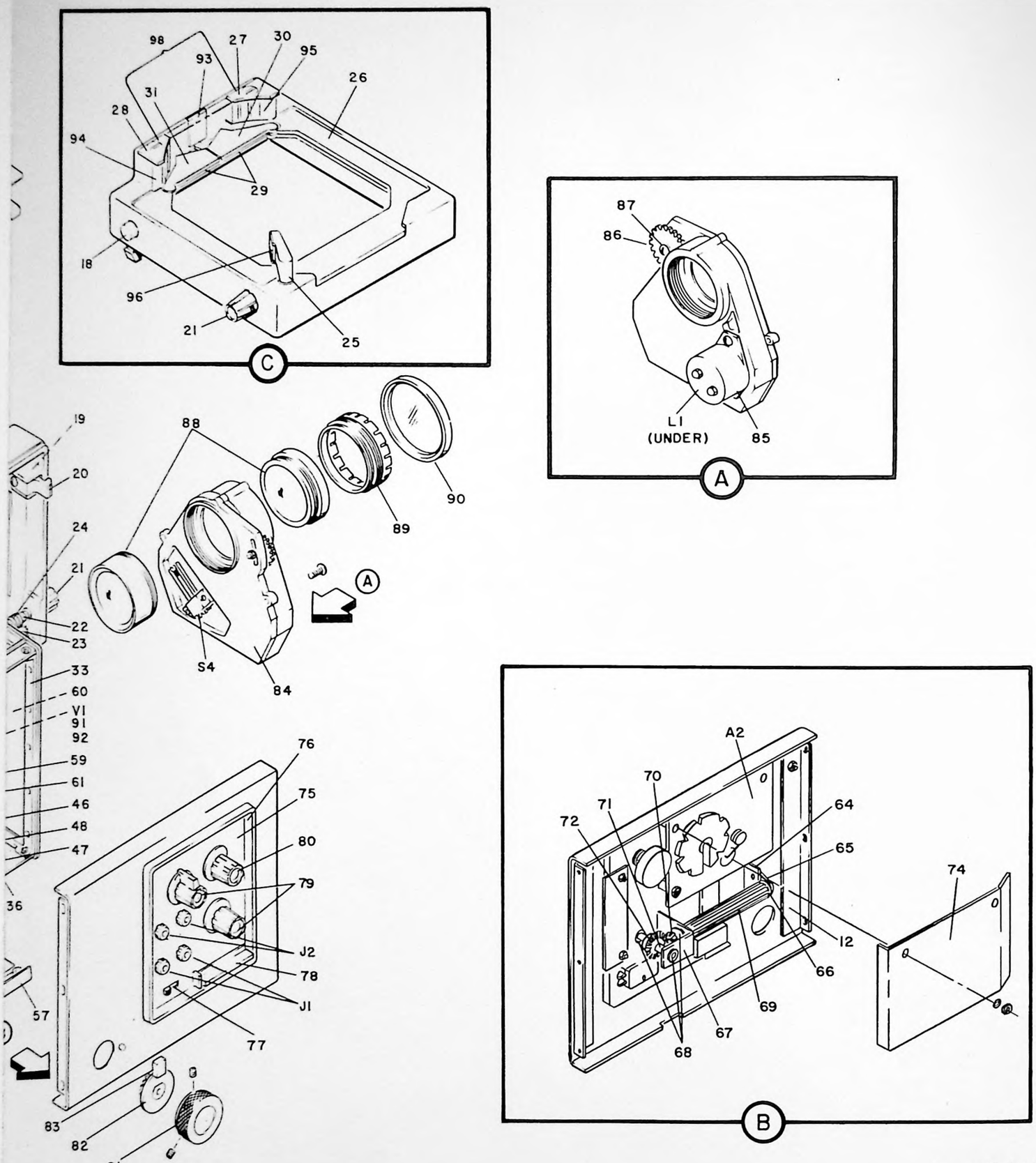



*Figure 7-4. Model 197A Exploded View*

Add: MP59, HP Part No. 00197-48301; LENS:ULTRAVIOLET LIGHT; Mfr Code 28480, Mfr Part No. 00197-48301.

Add: MP60, HP Part No. 00197-04110, MASK:ULTRAVIOLET LIGHT; Mfr Code 28480, Mfr Part No. 00197-04110.

Add: MP61, HP Part No. 00197-20502; REFLECTOR: ULTRAVIOLET LIGHT; Mfr Code 28480, Mfr Part No. 00197-20502.

MP75: Change HP Part No. and Mfr Part No. to 00197-00205; description unchanged.

Add: MP77, HP Part No. 00197-04109; MASK: SWITCH; Mfr Code 28480, Mfr Part No. 00197-04109.

MP79: Change qty to 2.

Add: MP89, HP Part No. 5040-0431; ADAPTER: FILTER; Mfr Code 28480, Mfr Part No. 5040-0431.

Add: MP90, HP Part No. 1000-0011; FILTER:ULTRAVIOLET; Mfr Code 28480, Mfr Part No. 1000-0011.

Add: MP91, HP Part No. 4330-0433, TUBE:FILTER GLASS, ULTRAVIOLET; Mfr Code 28480, Mfr Part No. 4330-0433.

Add: MP92, HP Part No. 00197-07107, GASKET: ULTRAVIOLET LIGHT; Mfr Code 28480, Mfr Part No. 00197-07107.

Add: MP99, HP Part No. 00197-68101, WINDOW: FILTER, ULTRAVIOLET LIGHT; Mfr Code 28480, Mfr Part No. 00197-68101.

Add: R1, HP Part No. 0698-3605, R:FXD METOX 15 OHM 5% 2W; Mfr Code 28480, Mfr Part No. 0689-3605.

Add: R2, HP Part No. 2100-2049, R:VAR COMP 50K OHM —10%+30% 2W; Mfr Code 28480, Mfr Part No. 2100-2049.

Add: S3, HP Part No. 3101-0903, SWITCH:SLIDE DP3T 0.5A 125V AC/DC (GRAT ILLUM); Mfr Code 79727, Mfr Part No. G128S-0003.

Add: V1, HP Part No. 2140-0254, LAMP:FLUORESCENT ULTRAVIOLET; Mfr Code 08806, Mfr Part No. MF2T6/BL.

Add: XV1, HP Part No. 1450-0147, LAMPHOLDER: BAYONET SOCKET; Mfr Code 72765, Mft Part No. 4369-051.

Figure 8-3,
Replace with figure 7-5.

*Table 7-2. Replaceable Parts for Instrument Serial Prefixes 610- through 913-*

| Ref Desig | hp Part No. | | TQ | Description | | |
|---|---|---|---|---|---|---|
| A1 | 00197-66501 | | 1 | A: etched circuit board shutter control | | |
| A2 | 00197-61901 | | 1 | A: switch shutter speed | | |
| C1 | 0160-0380 | | 1 | C: fxd my 0.22 μf 10% 200vdcw | | |
| C2 - C9 | | | | Not assigned | | |
| C10 | 0150-0121 | | 4 | C: fxd cer 0.1 μf -20% +80% 50vdcw | | |
| C11 | 0150-0081 | | 3 | C: fxd cer 0.01 μf -20% +80% 500vdcw | | |
| C12 | 0160-0962 | | 1 | C: fxd my 1 μf 5% 50vdcw | | |
| C13 | 0150-0081 | | | C: fxd cer 0.01 μf -20% +80% 50vdcw | | |
| C14 | 0180-0045 | | 1 | C: fxd elect al 20μf -10% +75% 25vdcw | | |
| C15 | 0150-0050 | | 1 | C: fxd cer 1000 pf 600vdcw | | |
| C16 | 0180-0049 | | 3 | C: fxd elect al 20 pf -10% +75% 50vdcw | | |
| C17 | 0150-0121 | | | C: fxd cer 0.1 μf -20% +80% 50vdcw | | |
| C18 | 0180-1782 | | 1 | C: fxd elect ta 22 μf 5% 35vdcw | | |
| C19 | 0180-0101 | | 1 | C: fxd elect ta 1.8 μf 5% 35vdcw | | |
| C20 - C30 | | | | Not assigned | | |
| C31 | 0150-0121 | | | C: fxd cer 0.1 μf -20% +80% 50vdcw | | |
| C32 | 0180-1784 | | 1 | C: fxd elect al 1000 μf -10% +75% 40vdcw | | |
| C33 | 0180-0058 | | 1 | C: fxd elect al 50 μf -10% +75% 25vdcw | | |
| C34 - C40 | | | | Not assigned | | |
| C41 | 0150-0081 | | | C: fxd cer 0.01 μf -20% +80% 500vdcw | | |
| C42 | 0180-0216 | | 1 | C: fxd elect ta 12 μf 10% 35vdcw | | |
| C43 - C45 | | | | Not assigned | | |
| C46 | 0180-0049 | | | C: fxd elect al 20 pf -10% +75% 50vdcw | | |
| C47 | 0150-0121 | | | C: fxd cer 0.1 μf -20% +80% 50vdcw | | |
| C48 | | | | Not assigned | | |
| C49 | 0170-0024 | | 1 | C: fxd my .022 uf 20% 200 vdcw | | |
| C50 | | | | Not assigned | | |
| C51 | 0180-2281 | | | C: fxd elect al 20 μf -10% +75% 75 vdcw | | |
| CR10 | 1901-0040 | | 2 | CR: si | | |
| CR11 | 1901-0025 | | 16 | CR: si | | |
| CR12 | 1901-0025 | | | CR: si | | |
| CR13 | 1901-0025 | | | CR: si | | |
| CR14 | 1901-0025 | | | CR: si | | |
| CR15 | | | | Not assigned | | |
| CR16 | 1901-0025 | | | CR: si | | |
| CR17 | 1901-0025 | | | CR: si | | |
| CR18 - CR30 | | | | Not assigned | | |
| CR31 | 1901-0025 | | | CR: si | | |
| CR32 | 1901-0049 | | 10 | CR: si | | |
| CR33 | 1901-0049 | | | CR: si | | |
| CR34 | 1901-0025 | | | CR: si | | |
| CR35 | 1902-0026 | | 1 | CR: avalanche 36.5 v | | |
| CR36 | | | | Not assigned | | |
| CR37 | 1901-0025 | | | CR: si | | |
| CR38 | 1902-0031 | | 1 | CR: avalanche 12.7v | | |
| CR39 - CR40 | 1901-0040 | | | CR: si | | |
| CR42 | | | | Not assigned | | |
| CR43 | 1901-0025 | | | CR: si | | |

*Table 7-2. Replaceable Parts for Instrument Serial Prefixes 610- through 913- (Cont'd)*

| Ref Desig | hp Part No. | | TQ | Description | | |
|---|---|---|---|---|---|---|
| CR44 & CR45 | | | | Not assigned | | |
| CR46 | 1901-0025 | | | CR: si | | |
| CR47 | 1901-0025 | | | CR: si | | |
| CR48 - CR50 | | | | Not assigned | | |
| CR51 | 1901-0025 | | | CR: si | | |
| CR52 | 1901-0025 | | | CR: si | | |
| CR53 | 1901-0025 | | | CR: si | | |
| CR54 | 1901-0025 | | | CR: si | | |
| CR55 | | | | Not assigned | | |
| CR56 | 1901-0049 | | | CR: si | | |
| CR57 | 1901-0049 | | | CR: si | | |
| CR58 | 1901-0049 | | | CR: si | | |
| CR59 | 1901-0049 | | | CR: si | | |
| CR60 | | | | Not assigned | | |
| CR61 | 1901-0049 | | | CR: si | | |
| CR62 | 1901-0049 | | | CR: si | | |
| CR63 | 1901-0049 | | | CR: si | | |
| CR64 | 1901-0049 | | | CR: si | | |
| F1 | 2110-0089 | | 1 | F: miniature 1/4 amp | | |
| J1 | 1251-0202 | | 4 | J: banana black (2 required) | | |
| J2 | 1251-0202 | | | J: banana black (2 required) | | |
| J3 | 00197-47601 | | 1 | J: power receptacle | | |
| K41A | 0490-0310 | | 1 | K: coil reed relay | | |
| K41B | 0490-0313 | | 1 | K: switch reed spst | | |
| L1 | 5080-0471 | | 1 | L: rotary solenoid | | |
| Q11 | 1853-0062 | | 2 | Q: si pnp | | |
| Q12 | 1853-0036 | | 2 | Q: si pnp | | |
| Q13 - Q30 | | | | Not assigned | | |
| Q31 | 1850-0098 | | 1 | Q: ge pnp | | |
| Q32 - Q40 | | | | Not assigned | | |
| Q41 | 1853-0062 | | | Q: si pnp | | |
| Q42 | 1853-0036 | | | Q: si pnp | | |
| R2 | 0757-0394 | | 1 | R: fxd metflm 51.1 ohms 1% 1/8w | | |
| R3 | 0757-0470 | | 1 | R: fxd metflm 162k ohms 1% 1/8w | | |
| R4 | 0757-0458 | | 1 | R: fxd metflm 51.1k ohms 1% 1/8w | | |
| R5 | 0757-0485 | | 1 | R: fxd metflm 681k ohms 1% 1/8w | | |
| R6 | 0757-0468 | | 1 | R: fxd metflm 130k ohms 1% 1/8w | | |
| R7 | 0757-0474 | | 2 | R: fxd metflm 243k ohms 1% 1/8w | | |
| R8 | 0757-0464 | | 1 | R: fxd metflm 90.9k ohms 1% 1/8w | | |
| R9 | 0757-0455 | | 3 | R: fxd metflm 36.5k ohms 1% 1/8w | | |
| R10 | 0757-0438 | | | R: fxd metflm 5110 ohms 1% 1/8w | | |
| R11 | 0757-0474 | | | R: fxd metflm 243k ohms 1% 1/8w | | |
| R12 | 0757-0438 | | 2 | R: fxd metflm 5110 ohms 1% 1/8w | | |
| R13 | 0757-0283 | | 1 | R: fxd metflm 2000 ohms 1% 1/8w | | |
| R14 | 0684-1051 | | 1 | R: fxd comp 1 megohm 10% 1/4w | | |
| R15 | 0757-0465 | | 2 | R: fxd metflm 100k ohms 1% 1/8w | | |
| R16 | 0757-0447 | | 2 | R: fxd metflm 16.2k ohms 1% 1/8w | | |
| R17 | 0757-0745 | | 1 | R: fxd metflm 4320 ohms 1% 1/4w | | |

*Table 7-2. Replaceable Parts for Instrument Serial Prefixes 610- through 913- (Cont'd)*

| Ref Desig | hp Part No. | | TQ | Description | | |
|---|---|---|---|---|---|---|
| R18 - R20 | | | | Not assigned | | |
| R21 | 0757-0438 | | | R: fxd metflm 5110 ohms 1% 1/8w | | |
| R22 | 0757-0455 | | 1 | R: fxd metflm 36.5k ohms 1% 1/8w | | |
| R23 | | | | Not assigned | | |
| R24 | 0757-0465 | | | R: fxd metflm 100k ohms 1% 1/8w | | |
| R25 | 0757-0481 | | 1 | R: fxd metflm 475k ohms 1% 1/8w | | |
| R26 - R30 | | | | Not assigned | | |
| R31 | 0758-0017 | | 1 | R: fxd metox 1500 ohms 5% 1/2w | | |
| R32 | 0758-0057 | | 1 | R: fxd metox 5600 ohms 5% 1/2w | | |
| R33 | 0758-0003 | | 3 | R: fxd metox 1000 ohms 5% 1/2w | | |
| R34 | 0687-3901 | | 1 | R: fxd comp 39 ohms 10% 1/2w | | |
| R35 | 0758-0003 | | | R: fxd metox 1000 ohms 5% 1/2w | | |
| R36 & R37 | | | | Not assigned | | |
| R38 | 0758-0003 | | | R: fxd metox 1000 ohms 5% 1/2w | | |
| R39 & R40 | | | | Not assigned | | |
| R41 | 0757-0431 | | 1 | R: fxd metflm 2430 ohms 1% 1/8w | | |
| R42 | 0757-0461 | | 1 | R: fxd metflm 68.1k ohms 1% 1/8w | | |
| R43 | 0757-0447 | | | R: fxd metflm 16.2k ohms 1% 1/8w | | |
| R44 | 0757-0455 | | | R: fxd metflm 36.5k ohms 1% 1/8w | | |
| R45 | | | | Not assigned | | |
| R46 | 0811-1626 | | 1 | R: fxd ww 4.7 ohms 10% 2w | | |
| R47 | 0811-1627 | | 1 | R: fxd ww 12 ohms 10% 2w | | |
| R48 | | | | Not assigned | | |
| R49 | 2100-2049 | | 1 | R: var comp 50k ohms -10% +30% 2w | | |
| S1 | 3101-0200 | | 1 | S: pushbutton spdt (shutter) | | |
| S2 | 3100-1314 | | 1 | S: rotary 10 position 2 section | | |
| S3 | 3101-0903 | | 1 | S: slide dp-3 pos min grat illum | | |
| S4 | 00197-44801 | | 1 | S: sync contact assy | | |
| T1 | 9100-1106 | | 1 | T: power | | |
| TB1 | 00197-26502 | | 1 | TB: u v light | | |
| V1 | 2140-0254 | | 1 | V: fluorescent ultraviolet 2w | | |
| W1 | 8120-0078 | | 1 | W: power input | | |
| W2 | 00197-61601 | | 1 | W: ribbon | | |
| XF1 | | | | Consists of: | | |
| | 1400-0110 | | 1 | Body: fuseholder | | |
| | 1400-0111 | | 1 | Nut: fuseholder | | |
| | 1400-0210 | | 1 | Cap: fuseholder | | |
| XV1 | 1450-0147 | | 1 | XV: bayonet | | |

*Table 7-2. Replaceable Parts for Instrument Serial Prefixes 610- through 913- (Cont'd)*

| Fig 6-1 MP No. | hp Part No. | | TQ | Description | | |
|---|---|---|---|---|---|---|
| 1 | 4320-0019 | | 1 | Mask: face | | |
| 2 | 00197-44101 | | 1 | Cover-end: hood top | | |
| 3 | 00197-44102 | | 1 | Cover-end: hood bottom | | |
| 4 | 00197-44901 | | 1 | Door: viewing hood | | |
| 5 | 1460-0279 | | 1 | Spring: door | | |
| 6 | 00197-00101 | | 1 | Hood: viewing | | |
| 7 | 1440-0035 | | 1 | Handle: carrying (incl attaching hardware) | | |
| 8 | 00197-44701 | | 1 | Seal: light | | |
| 9 | 00197-01207 | | 1 | Bracket: hood front | | |
| 10 | 00197-01203 | | 1 | Bracket: hood rear | | |
| 11 | 00197-04112 | | 1 | Cover: camera L.H. | | |
| 12 | 00197-01209 | | 1 | Bracket: rear mounting | | |
| 14 | 00197-01211 | | 1 | Bracket: power receptacle | | |
| 15 | 0380-0046 | | 2 | Spacer: cover pc board | | |
| 16 | 00197-00104 | | 1 | Cover: pc board | | |
| 17 | 00197-69502 | | 1 | Frame: mounting | | |
| 18 | 00197-27401 | | 1 | Button: latch | | |
| 19 | 1460-0278 | | 1 | Spring: latch | | |
| 20 | 00197-25001 | | 1 | Latch: swing-away | | |
| 21 | 0370-0190 | | 1 | Knob: mounting lock | | |
| 22 | 00197-23704 | | 1 | Shaft: mounting lock | | |
| 23 | 00197-22408 | | 1 | Gear: worm | | |
| 24 | 1430-0104 | | 1 | Worm | | |
| 25 | 00197-69503 | | 1 | Lever: mounting lock | | |
| 26 | 00197-04701 | | 1 | Gasket: mounting | | |
| 27 | 00197-01205 | | 1 | Retainer: mounting L.H. | | |
| 28 | 00197-01206 | | 1 | Retainer: mounting R.H. | | |
| 29 | 00197-04801 | | 2 | Wiper: mount | | |
| 30 | 00197-04702 | | 1 | Gasket: wiper L.H. | | |
| 31 | 00197-04704 | | 1 | Gasket: wiper R.H. | | |
| 32 | 00197-05101 | | 1 | Hinge: swing-away | | |
| 33 | 00197-62002 | | 1 | Assy: frame front | | |
| 34 | 00197-62001 | | 1 | Assy: frame rear | | |
| 35 | 00197-20501 | | 2 | Trim: camera | | |
| 36 | 00197-00102 | | 1 | Plate: bottom | | |
| 37 | 00197-60601 | | 1 | Assy: bellows | | |
| 38 | 00197-40601 | | 1 | Seal: light | | |
| 39 | 00197-22001 | | 1 | Plate: detent | | |
| 40 | 00197-64301 | | 1 | Assy: detent | | |
| 41 | 00197-09101 | | 4 | Spring: leaf detent | | |
| 42 | 00197-05002 | | 1 | Latch: detent | | |
| 43 | 00197-47403 | | 1 | Button: detent | | |
| 44 | 1460-0277 | | 1 | Spring: detent | | |
| 45 | 10353-60001 | | 1 | Assy: camera back | | |
| 46 | 00197-64701 | | 1 | Assy: shutter board | | |
| 47 | 00197-41703 | | 2 | Support: front | | |
| 48 | 00197-23702 | | 2 | Shaft: carriage | | |
| 49 | 00197-41704 | | 1 | Support: rear L.H. | | |

*Table 7-2. Replaceable Parts for Instrument Serial Prefixes 610- through 913- (Cont'd)*

| Fig 6-1 MP No. | hp Part No. | | TQ | Description | | |
|---|---|---|---|---|---|---|
| 50 | 00197-41705 | | 1 | Support: rear R.H. | | |
| 51 | 00197-22403 | | 2 | Gear: carriage drive | | |
| 52 | 00197-23705 | | 1 | Shaft: carriage lock | | |
| 53 | 00197-41204 | | 1 | Clamp: carriage lock | | |
| 54 | 00197-22407 | | 1 | Screw: carriage clamp | | |
| 55 | 0570-0164 | | 1 | Screw: reduction ratio | | |
| 56 | 00197-48801 | | 1 | Grommet | | |
| 57 | 00197-04106 | | 1 | Cover: bottom | | |
| 58 | 00197-44601 | | 1 | Plate: focus | | |
| 59 | 00197-48301 | | 1 | Lens: ultraviolet light | | |
| 60 | 00197-04110 | | 1 | Mask: ultraviolet light | | |
| 61 | 00197-20502 | | 1 | Reflector: ultraviolet light | | |
| 62 | 00197-04111 | | 1 | Cover: camera R.H. | | |
| 63 | 00197-01208 | | 1 | Bracket: front mounting R.H. | | |
| 64 | 00197-01210 | | 1 | Bracket: pinion | | |
| 65 | 00197-04703 | | 1 | Support: pinion | | |
| 66 | 0400-0068 | | 1 | Bushing | | |
| 67 | 00197-01201 | | 1 | Bracket: gear | | |
| 68 | 0400-0067 | | 3 | Bushing | | |
| 69 | 00197-22405 | | 1 | Shaft: splined | | |
| 70 | 00197-22401 | | 1 | Gear: pinion | | |
| 71 | 00197-23701 | | 1 | Shaft: f-drive | | |
| 72 | 00197-22402 | | 1 | Gear: bevel | | |
| 73 | 00197-01202 | | 2 | Bracket: bezel retainer | | |
| 74 | 00197-00103 | | 1 | Cover: switch | | |
| 75 | 00197-00201 | | 1 | Panel: control | | |
| 76 | 00197-22004 | | 1 | Bezel: control panel | | |
| 77 | 00197-04109 | | 1 | Mask: switch | | |
| 78 | 00197-47402 | | 1 | Lever: shutter release | | |
| 79 | 0370-0133 | | 2 | Knob: skirted | | |
| 80 | 0370-0077 | | 1 | Knob: skirted bar | | |
| 81 | 00197-27402 | | 1 | Knob: focus | | |
| 82 | 00197-65001 | | 1 | Lock: focus | | |
| 83 | 00197-47401 | | 1 | Button: focus lock | | |
| 84 | 00197-69501 | | 1 | Assy: shutter and iris | | |
| 85 | 00197-22005 | | 1 | Cover: shutter solenoid | | |
| 86 | 00197-22404 | | 1 | Gear: idler | | |
| 87 | 00197-21702 | | 1 | Bushing: gear | | |
| 88 | 1000-0702 | | 1 | Lens: f/1.9 75 mm | | |
| 89 | 5040-0431 | | 1 | Adapter: filter | | |
| 90 | 1000-0011 | | 1 | Filter: ultraviolet | | |
| 91 | 4330-0433 | | 1 | Sleeve: filter ultraviolet | | |
| 92 | 00197-07107 | | 1 | Gasket: UV light | | |
| 93 | 00197-41002 | | 1 | Gasket: foot center | | |
| 94 | 00197-41004 | | 1 | Gasket: foot left | | |
| 95 | 00197-41003 | | 1 | Gasket: foot right | | |
| 96 | 00197-41001 | | 1 | Gasket: foot level | | |
| 97 | 00197-00204 | | 1 | Panel: sub | | |

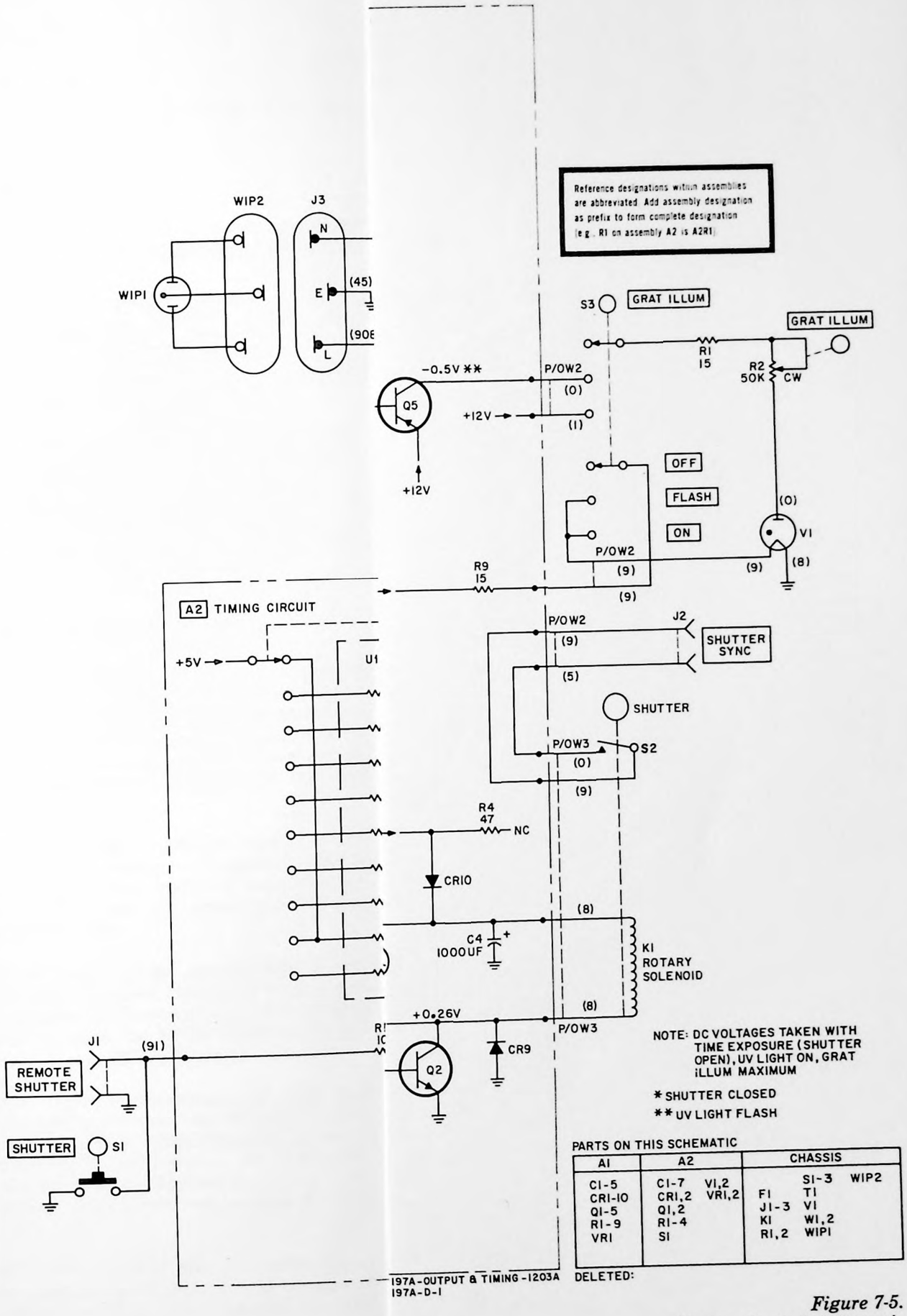



*Figure 7-5.*
*Shutter Control Schematic*
7-11/(7-12 blank)

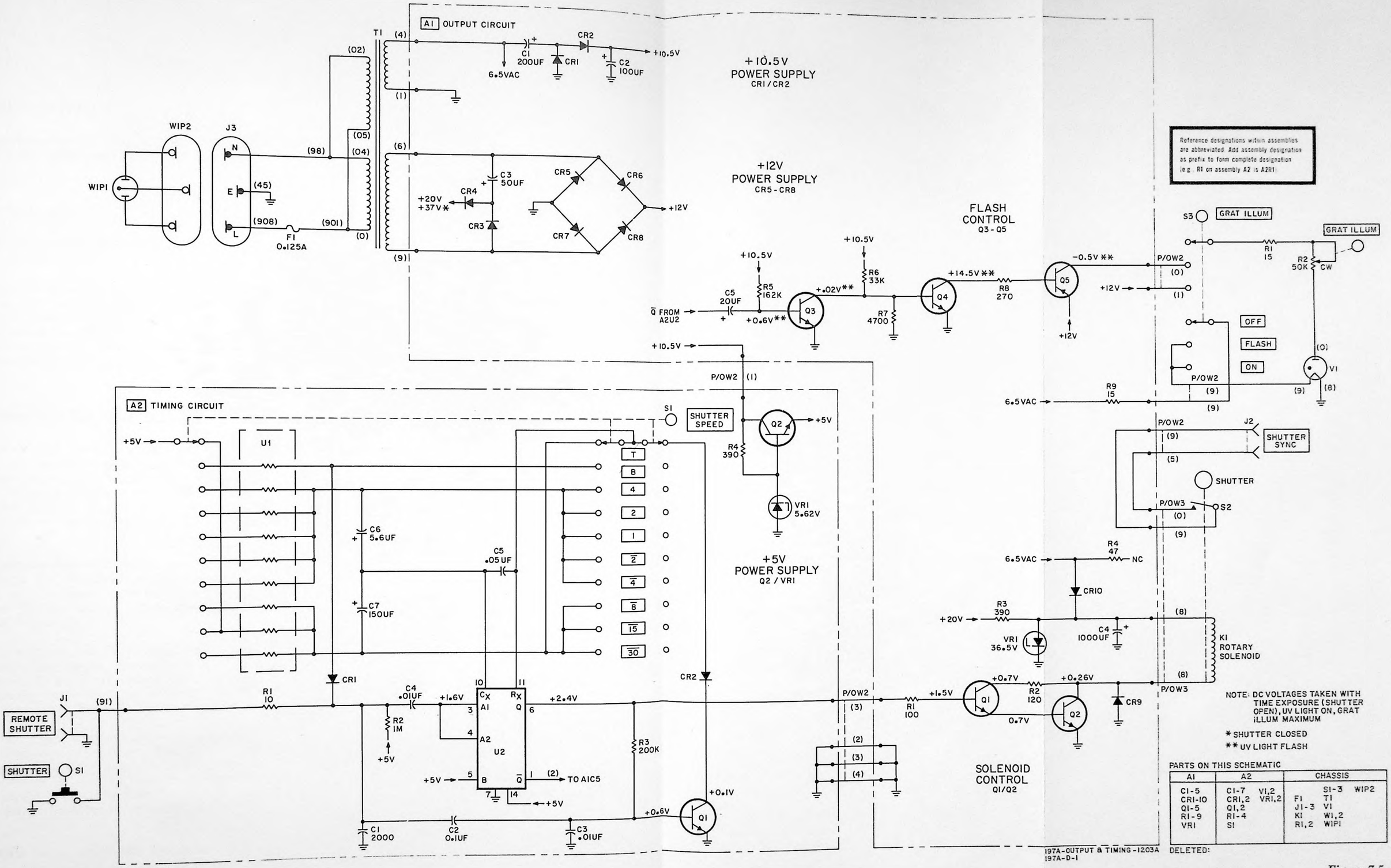



*Figure 7-5.*
*Shutter Control Schematic*
7-11/(7-12 blank)

# SECTION VIII

# SCHEMATICS AND TROUBLESHOOTING

## 8-1. INTRODUCTION.

8-2. This section contains the schematic, repair and replacement information, and component-identification illustrations.

## 8-3. SCHEMATIC.

8-4. The schematic is drawn to show electronic functions of the circuits.

8-5. All components within the bordered areas of the schematic are physically located on etched circuit boards. Components not physically located on an etched circuit board are shown in the unbordered areas of the schematic. Location of components on assemblies are illustrated on drawings adjacent to the schematic.

## 8-6. PREVENTIVE MAINTENANCE.

8-7. Preventive maintenance consists of periodic performance checks, mechanical inspection, lubrication, and other services designed to prevent breakdown and failure. Performance checks and adjustments are covered in Section V of this manual. Other preventive maintenance services are covered in the following paragraphs.

**8-8. MECHANICAL INSPECTION.** Periodically inspect the instrument for damaged components, excess grease, dirt, and corrosion. Look for loose and misaligned parts. Ensure that all screws and fasteners are tight and serviceable.

8-9. Painted surfaces can be cleaned with a commercial, spray-type, window cleaner or with a mild soap and water solution. Excess grease can be removed with a degreaser such as M-180 FREON TF DEGREASER produced by Miller-Stevenson Company.

8-10. Corroded spots are best removed with soap and water. Stubborn residues can best be removed with a fine abrasive. When using abrasives, be careful that fine particles do not fall into the instrument. Such areas should be protected from further corrosion by an application of a silicone resin such as GE DRI-FILM 88.

**8-11. CAMERA BACK CLEANING.** The entire camera back interior should be inspected and cleaned, if necessary, before installing a new film pack. In particular, it should be inspected for residue from any developer reagent that may have spilled. The residue should be wiped off carefully with a damp cloth to avoid scratching or spotting subsequent prints. Use a nonmetallic object to dislodge any dried reagent.

**8-12. LENS CLEANING.** Both lens and filter should be inspected regularly and cleaned as necessary. For cleaning, use lens tissue or, for heavy smudges or grease spots (such as fingerprints), a commercial lens cleaner. When cleaning the lens avoid undue pressure which could affect the lens coating.

**8-13. LUBRICATION.** Periodic lubrication of the camera is not required. If there is a noticeable binding at any of the points listed in table 8-1, a small amount of lubricant should be applied.

*Table 8-1. Camera Lubrication Points*

| Location | Figure 6-1 MP No. | Recommended Lubricant |
|---|---|---|
| Mounting lock worm gear | 23, 24 | Lubriplate |
| Carriage shafts (2 places) | 48 | Graphite powder |
| Carriage drive gears (2 places) | 51 | Graphite powder |
| Carriage lock drive | 54, 82 | Lubriplate |
| Reduction ratio screw | 55 | Lubriplate |
| Iris drive gears | 69, 86 | Lubriplate |
| f/stop bevel gear | 70, 71 | Lubriplate |

## 8-14. REPAIR AND REPLACEMENT.

8-15. Repair of the Model 197A consists of replacing defective components located during troubleshooting. The following paragraphs provide information on access to instrument components and special servicing information for etched circuit boards.

**CAUTION**

When replacing components mounted on the stud-welded aluminum studs, i.e., brackets, covers, and pc board, do not tighten nuts to more than 5 inch-pounds torque.

**8-16. SIDE PANEL ACCESS.** Both side panels can be detached from the camera frame for access to components. When detached, the side panels will lay flat and the frame may be removed and set aside. The panels are, however, still connected together by the ribbon cable which must be removed before complete separation of the panels is achieved. To detach the side panels from the camera frame, proceed as follows:

a. Remove bottom cover (6 screws).

b. Remove FOCUS and LOCK knobs (note position of LOCK knob).

c. Open mounting frame.

d. Remove three screws on left side (for right hand cover).

e. Press front of right-hand cover from inside of camera until cover is clear of camera frame, then pull forward to disengage cover from guide pins on rear of frame.

**NOTE**

Disengage cable grommet from camera frame if panels are to be separated from frame.

f. Remove three screws (first, third, and fifth) from right side (for left-hand cover).

g. Press front of left-hand cover from inside of camera until cover is clear of camera frame, then pull forward to disengage cover from guide pins on rear of frame.

h. Reverse procedure to replace side panels.

**CAUTION**

When replacing side panels, ensure that splined shaft and iris idler gear are mated correctly.

i. When side panels are replaced, accomplish LENS f/NO. adjustment as described in Section V.

**8-17. SERVICING ETCHED CIRCUIT BOARDS.** The etched circuit boards have plated through component holes. This allows components to be removed or replaced by unsoldering or soldering from either side of the board. When removing large components such as potentiometers, rotate the soldering iron tip from lead to lead while applying pressure to the part to lift it from the board. HP Service Note M-20E contains additional information for repair of etched circuit boards.

8-18. When removing a semiconductor, use long-nosed pliers as a heat sink between the device and the soldering iron. When replacing a semiconductor, ensure sufficient lead length to dissipate the soldering heat by using the same length of exposed lead as used for the original part.

## 8-19. TROUBLESHOOTING.

**WARNING**

Read the Safety Summary at the front of this manual before troubleshooting the instrument.

8-20. Troubleshooting the instrument consists of a thorough visual inspection, and then an electrical check if necessary. During the visual inspection, look for loose, broken, or binding mechanical components; loose or discolored electrical components or wiring; or any other similar condition which indicates a source of trouble. Repair any faulty component or connection that is encountered during the visual inspection and check instrument performance before continuing to troubleshoot the instrument.

8-21. If no obvious fault is located during the visual inspection, proceed with the electrical check. Use the block diagram (figure 4-2) and the schematic (figure 8-3) as aids in trouble isolation. Check dc voltages as shown on the schematic to further isolate the problem.

## 8-22. PRINT QUALITY IMPROVEMENT.

8-23. Most problems encountered in oscilloscope photography involve incorrect control settings or conditions of operation. These problems can often be avoided by closely following the mounting instructions in Section II, and the operating information in Section III. Some of the most common problems are discussed in the following paragraphs.

**8-24. LIGHT LEAKAGE.** Check for light leakage in the camera as follows:

a. Mount camera on oscilloscope, and apply power to camera.

b. Verify that there is no display on oscilloscope.

c. Set SHUTTER SPEED selector switch to 1 second.

d. Set LENS f/NO. control to 1.9.

e. Press SHUTTER control bar and develop resulting photograph.

f. Resulting print should be completely black.

**NOTE**

If light leakage occurs, refer to paragraph 8-25 for possible causes.

**8-25. FOGGING.** Fogging or undesirable light areas over all or part of the print can be caused by many factors. The two main causes are internal (within the oscilloscope) or external light leakage.

**8-26. Internal Sources.** Many causes of fogging originate in the oscilloscope itself. These problems can become difficult to control, especially when time exposures are required. Some of the most common faults are:

a. Excessive brilliance can cause general "blooming" of the trace which tends to illuminate entire screen. This can be corrected by decreasing display intensity.

b. Orange-yellow light emitted from cathode of un-aluminized CRT can cause fogging on time exposures. A blue filter over the CRT face or camera lens may help reduce this type of fogging.

c. An unblanked oscilloscope can also cause fogging, especially if it is being used for recording transients, since the spot remains visible until a transient occurs. This problem can be minimized by positioning the spot to a point just off display area, or by masking the spot with a small piece of tape.

**8-27. External Sources.** External light leakage is another common cause of film fogging. Some common sources are:

a. Improper mounting may not permit mounting frame light gasket to seat firmly against bezel.

b. A loose fitting bezel may permit stray light to enter edge of CRT face (or external graticule). Masking edges of bezel will usually solve this problem.

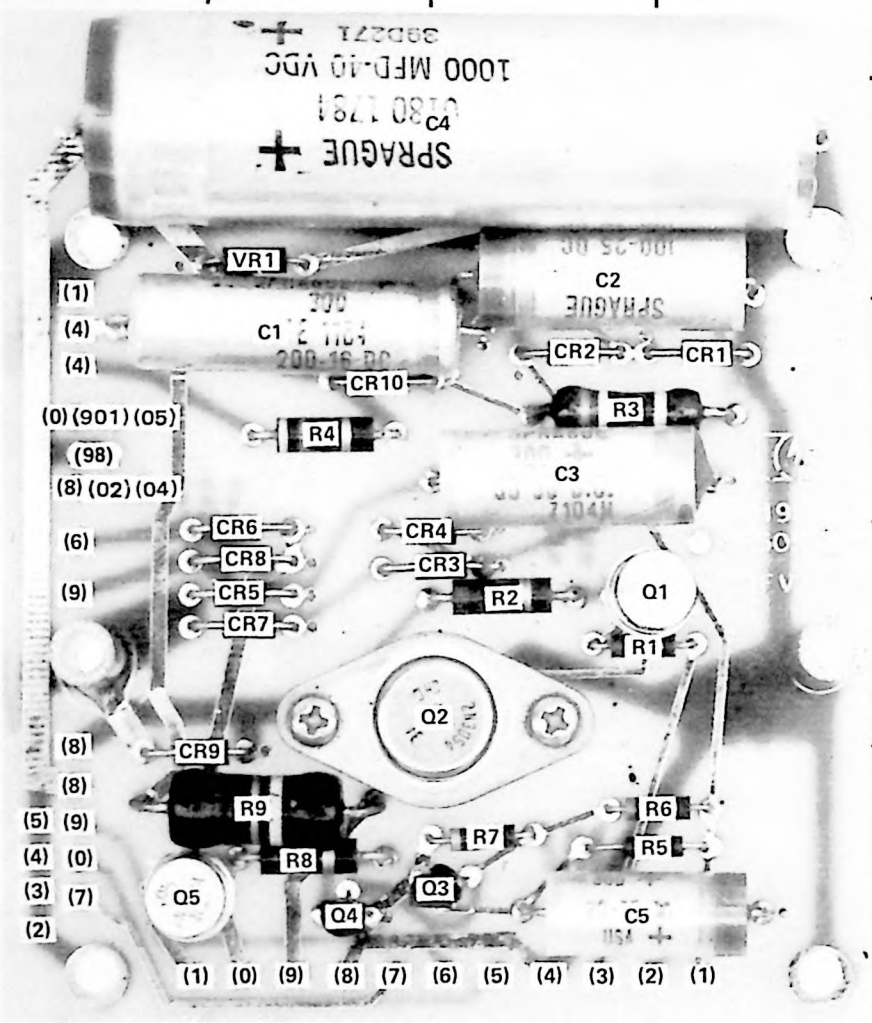
c. Light entering CRT internally through cover perforations of the instrument is more difficult to eliminate. Reduction of ambient light will probable be the most practical solution.

**CAUTION**

If a black cloth (or any other type of covering) is used over the oscilloscope for reduction of ambient light, do not cut off air circulation to the instrument.

**8-28. FILM TEARING.** Film damage due to tearing is usually caused by not pulling the yellow tab straight out when advancing the film. The tab should be pulled in a straight line parallel with the long axis of the camera back.

**8-29. PRINT IMPERFECTIONS.** Dark spots appearing at the same place on successive exposures may be caused by dust on the lens or filter. White spots on the print can be caused by an accumulation of developer residue or foreign matter on the pressure rollers in the camera back. Keeping the lens and inside of the camera back clean will eliminate many imperfections (refer to paragraph 8-11 for cleaning recommendations). A diagonal pattern on all prints indicates that the pressure rollers are worn or damaged.

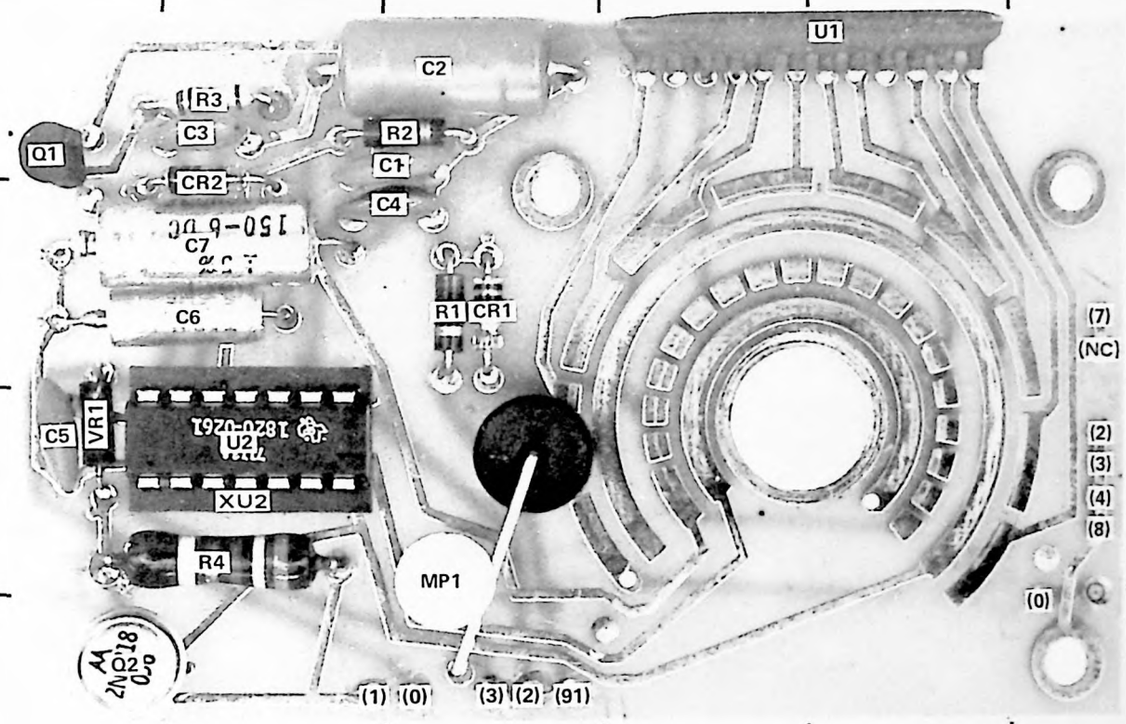



| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|
| C1 | C-3 | CR6 | C-4 | R1 | D-4 |
| C2 | D-2 | CR7 | C-4 | R2 | D-4 |
| C3 | D-3 | CR8 | C-4 | R3 | D-3 |
| C4 | D-2 | CR9 | B-5 | R4 | C-3 |
| C5 | D-5 | CR10 | C-3 | R5 | D-5 |
| CR1 | E-3 | Q1 | D-4 | R6 | D-5 |
| CR2 | D-3 | Q2 | D-4 | R7 | D-5 |
| CR3 | D-4 | Q3 | D-5 | R8 | C-5 |
| CR4 | C-4 | Q4 | C-5 | R9 | C-5 |
| CR5 | C-4 | Q5 | B-5 | VR1 | C-2 |

Circuit boards have plated through component holes. This permits soldering from either side of the board.

197A-R-1-10-75

*Figure 8-1. Output Circuit A1 Component Identification*




A2

Circuit boards have plated through component holes. This permits soldering from either side of the board.

| REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC | REF DESIG | GRID LOC |
|---|---|---|---|---|---|---|---|
| C1 | C-2 | C6 | B-3 | Q1 | A-2 | R4 | B-4 |
| C2 | C-2 | C7 | B-3 | Q2 | A-5 | VR1 | A-4 |
| C3 | B-2 | CR1 | C-3 | R1 | C-3 | U1 | E-2 |
| C4 | C-3 | CR2 | B-3 | R2 | C-2 | U2 | B-4 |
| C5 | A-4 | MP1 | C-4 | R3 | B-2 | XU2 | B-4 |

197A-R-4

*Figure 8-2. Timing Circuit A2 Component Identification*

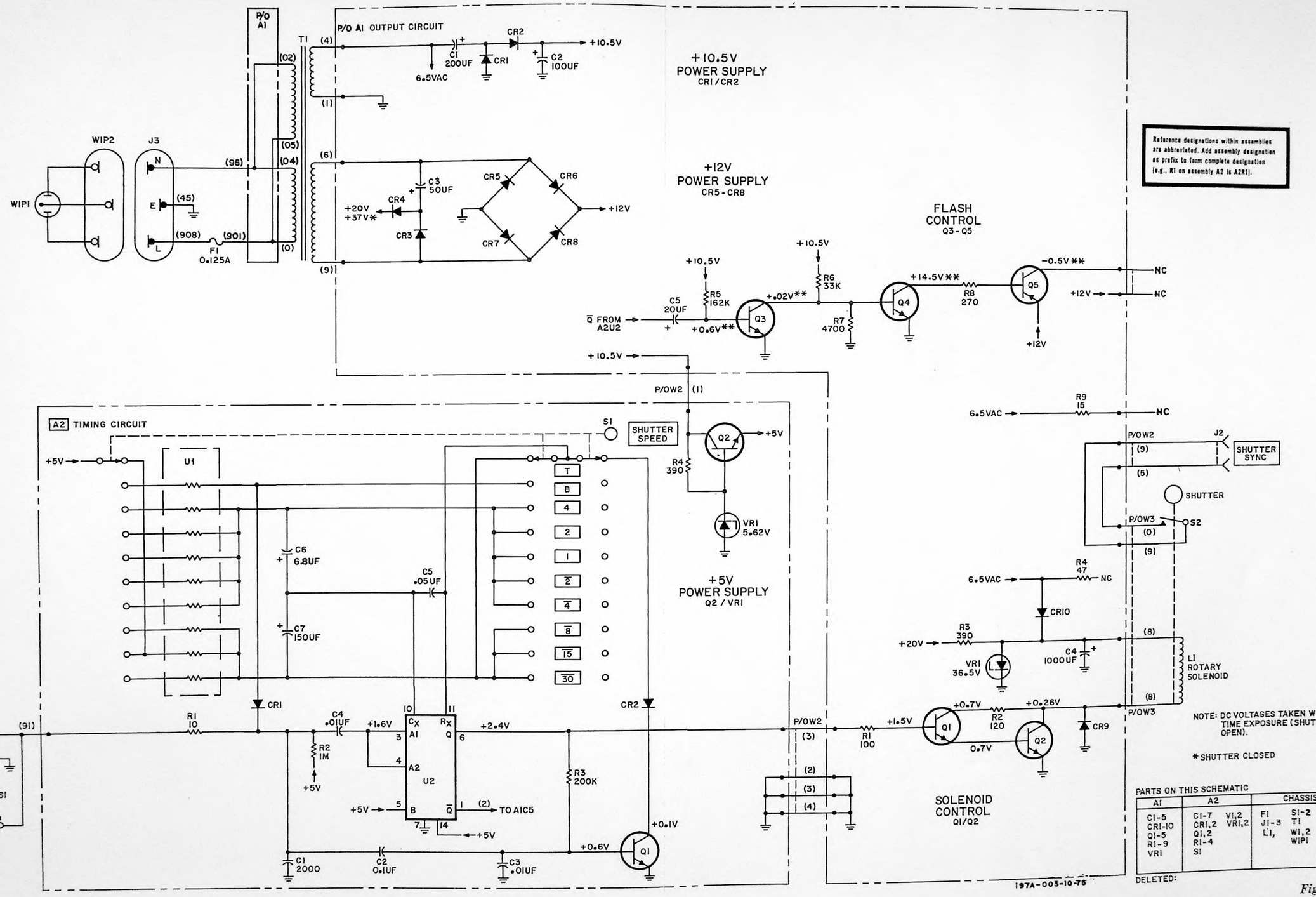



*Figure 8-3.*
*Shutter Control Schematic*

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